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AGRICULTURAL RESEARCH INSTITUTE
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THE

PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES

FOR THE YEAR

1911

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WITH THIRTY-ONE PLATES.

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CORRIGENDA.

Page 137, line 2—for *Nicotianum tabaccum*, read *Nicotiana tabacum.*
Page 205, lines 24 and 33
Page 206, lines 29 and 37
Page 207, line 24
Page 209, line 15
—for *Acthosus*, read *Achthosus.*
Page 294, line 15—for TRYMALTIS, read TRYMALITIS.
Page 196, line 11—*for* 422, *read* 442.
Page 287, line 2—for *Carpocapsa pomononella*, read *Carpocapsa pomonella.*
Page 328, line 24—*for* 1910, *read* 1911.
Page 334, line 30—*after* metanotum, *add* smooth.
Page 341, line 20—for *lutens*, read *luteus.*
Page 348, line 26—*for* earthern, *read* earthen.
Page 349, line 21—for *Megiselus*, read *Megischus.*
Page 354, line 24—for MEDINOSCHIZA, read NEDINOSCHIZA.
Page 355, line 21—*after* separated, *add* striæ.
,, line 23—for *Pegarthrum fuscipennis*, read *Pegarthrum fuscipenne.*
Page 361, line 28—*for* Bat. u. Zool., *read* Bot. u. Zool.
Page 386, line 3—for *A. berthoudi*, read *H. berthoudi.*
Page 452, line 36—for *P. lævis*, read *T. lævis.*
Page 540, line 7—for ELEUSINE ÆGYPTICA, read ELEUSINE ÆGYPTIACA.
Page 583, lines 3-4—for *E. coricea*, read *E. coriacea.*
Page 598, line 32—*for* tibia, *read* labia.
Page 600, line 30—*for* asthenogenetric, *read* asthenogenetic.

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PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES.

WEDNESDAY, MARCH 29TH, 1911.

The Thirty-sixth Annual General Meeting, and the Ordinary Monthly Meeting, were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 29th, 1911.

ANNUAL GENERAL MEETING.

Mr. C. Hedley, F.L.S., President, in the Chair.

The Minutes of the preceding Annual General Meeting (March 30th, 1910) were read and confirmed.

The President delivered the Annual Address.

PRESIDENTIAL ADDRESS.*

LADIES AND GENTLEMEN—

Among the announcements which I have to make to-night, at this our Thirty-sixth Annual Meeting, probably none will give you greater satisfaction or have a greater influence upon our future career than the statement that we now, for the first time, meet on our own property.

In giving us this Hall, the Founder gave all that was his to give, which was the leasehold of 89 years' tenure. Recently the estate came into the market. In consideration of the aim and work of the Society, and of the great interest of his predecessors in the title in Science, the land was generously offered to us by the proprietor, Col. Macarthur-Onslow, on exceptionally advantageous terms, and your Council embraced the opportunity of obtaining the fee simple of the block upon which this Hall stands. Since our former rent is equivalent to the interest earned by the purchase money, the transaction does not disturb income and expenditure, and from a financial standpoint may be regarded as a transference of investment. From a social and business point of view we have much improved our position, since we are free to go or to stay now or in the future as may suit our convenience. The associations that link us with the past are not now terminable with the lease.

Although our careful Treasurers have not only preserved our capital intact, but have rather added to it by accumulation, yet so much has the earning power of money shrunk that the purchasing capacity of our income is seriously diminished through alteration of industrial conditions. Especially do we feel the pinch in expenditure on publication, the very flower of our work. Since the object of our existence is the production and spread of knowledge, all else that we may do suffers, if our publication suffers. By direction of the Founder, the funds that we control are restricted each to its proper purpose. So that however worthy of support we may consider publication to be, we are unable to divert funds to this from other directions. For the future the money which has hitherto sufficed for an annual illustrated volume of from eight to nine hundred pages may only provide for from seven to eight hundred pages. We are threatened with this diminution while workers increase and more valuable papers are offered for publication.

One source of income which is at our disposal is the subscriptions of members. I now make to you an earnest appeal to augment this income by the enrolment of additional subscribers. Surely without great effort every active member could introduce two or three well-wishers of science from amongst his friends. To an invitation to join a Scientific Society, a frequent reply is that the person addressed does not regard himself or herself as competent to share our work or to join in our debates. May not they be reminded that they also serve who only stand and wait, that their subscriptions will be a welcome aid to the cause we all have at heart. Where authors are able and willing to defray a part of the cost of illustrating or printing their papers, such assistance would be gratefully accepted by the Council.

Our last volume, No. xxxv., of the Proceedings was issued in four parts, and has been distributed to members. It contained the thirty-one papers which were read at the monthly meetings.

By a combination of circumstances several Linnean Macleay Fellowships have been vacated lately. Dr. Goddard had hardly commenced his year's work when he received an appointment as Professor of Zoology and Geology at Victoria College, South Africa. He left Australia with our hearty congratulations and good wishes for his future career.

For the new year the Council had re-appointed Dr. Petrie and Mr. Cotton, and had appointed Mr. T. T. Flynn, B.Sc., Lecturer in Biology to the Tasmanian University, to a Fellowship in comparative anatomy and embryology. Recently Mr. Flynn withdrew from the Fellowship to accept a Professorship offered to him by the Senate of the Tasmanian University.

A few weeks ago Mr. Cotton resigned his Fellowship also, to join the teaching staff of the Geological Department, under Professor David. Mr. Cotton has, in our service, proved himself an enthusiastic and capable investigator, and we anticipate for him an honourable and useful career under his Alma Mater. It is pleasant to find that so many advantageous positions are within the reach of those qualified to hold our Fellowships.

In the Bacteriological Laboratory of the Society, Dr. Greig-Smith has investigated the bacterial flora of the stools of children afflicted with rickets. From the preponderance of the streptococci over the rod-shaped bacteria as compared with normal stools, he came to the conclusion that an increase in the streptococci is associated with the disease.

Another investigation led to the elucidation of a phenomenon of general occurrence in the household. The ordinary bath-sponge frequently becomes slimy from the action of certain bacteria which attack the substance of the sponge, converting it into slime. The nature of these microbes and of the slime has been described by the Macleay Bacteriologist.

The action of heat and of volatile disinfectants in increasing the fertility of the soil has recently received attention from those interested in agricultural science. The treatment reduces the number of bacteria, but the reduction is soon followed by an increase much above the normal. The greater increase means a greater decomposition of the organic matter of the soil, and consequent greater production of food-materials for the growing crop. Russell and the Rothamsted school claim that the heat and disinfectants act solely by destroying phagocytic protozoa, and that the removal of these permits the bacteria to increase. They deny that soils contain substances of the nature of toxins which are inimical to the growth of bacteria.

Believing that as soils are essentially a mixture of inert and nutritive materials in which bacteria are growing, they must contain toxic bacterial by-products, Dr. Greig-Smith began a series of experiments with soils and soil-extracts. He showed that extracts of soils, filtered through porcelain, do contain substances toxic to bacteria. These toxins are destroyed by heat, by storage and by sunlight. The behaviour of heat explains the benefit obtained by heating soils, and the action of sunlight shows that the toxin must be considered in questions relating to the fertilising effect of sunlight upon soils.

The Macleay Bacteriologist discovered in soil a substance which has hitherto been disregarded. This is agricere, a *mixture of saponifiable and unsaponifiable fatty substances*: it is soluble in fat-solvents such as chloroform, ether, carbon bisulphide, etc. The volatile fat-solvents have, in this relation, been considered as *disinfectants*, and this has doubtless obscured their real action upon the soil. The solvents dissolve the agricere, and carry it to the uppermost layers, where it is deposited upon the points of the soil-particles. The uniform "water-proofing" of the soil-particles is destroyed, and they are more easily attacked by the soil bacteria: decomposition being hastened, the fertility is increased.

It is interesting to note that in the January number of the Journal of the American Chemical Society, Schreiner and Shorey contribute two papers upon the glycerides of fatty acids and the paraffin hydrocarbons in soils. These are the saponifiable and unsaponifiable portions of the agricere of Greig-Smith.

In the department of Bio-chemistry Dr. J. M. Petrie has continued, during the past year, his studies on the nitrogenous compounds present in plants. The proteins separated by different methods from the seeds of *Acacia pycnantha* have been examined, and evidence has been obtained, by fractional precipitations, of the probable presence of three distinct proteins. Further investigation of the non-protein nitrogenous substances previously shown to constitute so considerable a part of these compounds which contain nitrogen has been carried out. These substances have not yet been isolated, and the main source of the non-protein nitrogen is still unknown. Cholin and xanthin bases account for some of this nitrogen, and it has now been shown that the greater proportion of these substances belongs to groups which decompose slowly on hydrolysis with liberation of ammonia. A number of experiments on the changes in the amounts of nitrogenous compounds during the ripening of seeds have ben conducted. The results obtained confirm the opinion that, as nitrogenous compounds accumulate in the seeds, there is a simultaneous increase in the amounts of both protein and non-protein nitrogenous compounds. No evidence has been obtained that the non-protein nitrogenous compounds in the seeds are transformed into proteins. Further experiments showed that the pods of leguminous plants may act as reserve-holders for the nitrogenous supply to the seeds, even when the pods are isolated from the plants.

The occurrence of a comparatively large amount of potassium-nitrate in the leaves of *Solandra* has been observed. Considerable interest is attached to this fact since the storage of nitrates, in other than very small amounts, is confined to a few plants only.

The constituents of the Sassafras tree of New South Wales, *Doryphora sassafras* have been investigated. A volatile essential oil has been obtained from the bark from which also an alkaloid has been separated. The amount of oil obtained from the bark is about 1 per cent. It is a fragrant oil and contains camphor among its constituents.

With Dr. Chapman, Dr. Petrie has continued the examination of the action of the latex of *Euphorbia peplus* on a photographic plate. Evidence has been obtained that the effect on the plate is not due to a gas or emanation given off from the dried juice. It is probable that the photographic action is due to a particle travelling approximately in a straight line and with a moderate velocity.

The Linnean Macleay Fellow in Geology, Mr. Leo A. Cotton, who has now rejoined the teaching staff of the Sydney University, reports that the earlier part of the year was devoted to the preparation of his memoir on the Ore-Deposits of Borah Creek, since published in our Proceedings. In this he traced an interesting connection between the sulphide ores and the related tin-deposits. Mr. Ward, of the Geological Survey of Tasmania, has been engaged in similar studies in his State. The results simultaneously and independently reached in New England and Tasmania confirm each observer in his conclusions.

In the field, Mr. Cotton resumed his investigations of the diamond-deposits at Copeton. After this he examined the wolfram-ores at Torrington, where recent mining development provided excellent opportunities of observation. These ores are important from a genetic point of view, being closely related to the tin ore-deposits. Indeed it is becoming clear that the formation of the wolfram-deposits is an integral part of the genesis of the tin-ores. Subsequently Queensland was visited for the purpose of correlating the Stanthorpe tin-deposits with those of New England.

The information thus gathered was digested in the laboratory. Three papers dealing with the wolfram-ores of Torrington, the tin-deposits of New England and the diamond-deposits of Copeton, respectively approach completion, and will be laid before you shortly. We anticipate that Mr. Cotton's contributions to our Proceedings will not cease with his Fellowship.

During the past Session, fourteen new members were elected, and three old members were lost to us by death, viz., Mr. W. F. Petterd of Launceston, Mr. W. Forsyth of Sydney, and Miss M. Lodder of Launceston.

In William F. Petterd we lost not only a fellow-member, but one of the pioneers of Australian Zoology. He was born in Hobart, June 12th, 1853, and died in Launceston, April 15th, 1910. A man of unusual energy and keen intellect, he developed in boyhood an ardent love for natural history. This was doubtless fostered by early association with William Legrand, the Hobart naturalist-bookseller and with the Rev. J. E. Tenison-Woods. Petterd became interested in shells, birds and insects. A smart bushman and good all-round collector, his services were appreciated by various science-lovers and institutions. Prof. McCoy and Dr. J. C. Cox were liberal patrons, who despatched him on various excursions. Taking every opportunity for travel, at an early age he had seen not only each Australian colony, but had visited the Solomons and some of the east Pacific groups as well.

He is frequently mentioned as the finder of new species described in the first volume of our Proceedings. Indeed he was intimately connected with our early history, as one who served on the Chevert Expedition. The Founder described him (These Proceedings, i., p. 36) with Messrs. Masters, Brazier and Spalding, as one of those "very competent taxidermists and collectors" whom he had engaged.

During the expedition he acquitted himself with credit as usual, but it concluded without satisfying his appetite for travel and adventure. He therefore resigned at Thursday Island, and, with another of like spirit, Mr. Lawrence Hargrave, afterwards famous for his studies in aëronautics, he joined Messrs. Stone and Kendall Broadbent. Returning to New Guinea, he explored with this party the then unknown country inland from Port Moresby.*

At the conclusion of this journey, worn with fever and hardship, and with an empty purse, he returned to his native town. He realised that pleasant though his wandering years had been, yet the pursuit of science had not aided his material prospects. Wisely resolving that science would be a better pastime than profession, he accepted a friend's offer of the management of a shop at Launceston. Here the qualities that had made him an excellent collector again brought him success. So that in a short time he had obtained possession of a profitable business. But his restless spirit sought further occupation. For mere amusement he took up the study of mineralogy. It thus chanced that he became proficient in mineral analysis at the time of the discovery of the silver mines of the West Coast. Prospectors soon learnt that sound information on the value of their ores could be obtained at Petterd's boot store. This association with mining development ultimately led to his election as chairman of several important companies.

His financial interest in the subject did not diminish his scientific taste. He formed the finest private collection of minerals in Australasia, including over 20,000 specimens, which he has bequeathed to the Tasmanian Museum. In conjunction with Mr. W. H. Twelvetrees, Tasmanian Government Geologist, he wrote several papers on the geology and mineralogy of Tasmania. At the time of his death an enlarged edition of his "Catalogue of Tasmanian Minerals" was passing through the press.

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* Stone, "Ten months in New Guinea."

Conchology was always a favourite subject. For some years he contributed papers on Tasmanian shells to the Quarterly Journal of Conchology. The Royal Society of Tasmania published a further series. He produced in 1879, "A Monograph of the Land Shells of Tasmania." Thirty years afterwards, in collaboration with myself, the subject was brought up-to-date in "A revised Census of the Terrestrial Mollusca of Tasmania." He also joined me, in 1905, in a deep-sea dredging excursion off Sydney. This was the first occasion on which any local workers had explored beyond the continental shelf in Australasia.

The conduct of large business enterprises and the pursuit of scientific studies still left Mr. Petterd time and enthusiasm for horticulture and philately. A seizure of the heart ended his strenuous life in his fifty-seventh year.

His old comrade in Papuan exploration did not long survive him. Kendall Broadbent died in Brisbane on January 15th, 1911, aged seventy-three. For about thirty years he had served the Queensland Museum as collector and taxidermist.

Another link with the past snapped at the death of Mrs. Helena Forde on the 24th November, 1910, at Parramatta, at the advanced age of nearly four score. Alexander Walker Scott was a member of an influential family in early colonial times. He resided on his estate of Ash Island on the Hunter River; and occupied himself in the pursuit of natural history. His two daughters, Harriet and Helena, whose married names in after life were Mrs. C. W. Morgan and Mrs Edward Forde respectively, grew up to share these intellectual pleasures. Their artistic talent found exercise in the careful delineation of the butterflies and moths, native to their home, in various stages of development. The drawings and descriptions thus prepared by the family attained publication under the title of "Australian Lepidoptera and their Transformations, drawn from life by Harriet and Helena Scott, with descriptions general and systematic by A. W.

Scott, M.A." The first three parts were issued in 1864. Mr. Scott's death occurred in 1883, after which the unpublished drawings, manuscript and unissued copies were transferred to the Trustees of the Australian Museum. After a long interval, four additional parts were issued by that Institution, from 1890-93. In recognition of their achievements the sisters were elected honorary members of our predecessor, the Entomological Society of New South Wales, in 1864. To these artist-naturalists we owe most of the figures in the scientific literature of the period, produced in Sydney. Thus they undertook the illustration of Dr. Cox's "Monograph of Australian Land Shells" in 1868. Continuing, these ladies prepared both drawings and lithographs for Krefft's "Snakes of Australia" in 1869. Two years afterwards the same author brought out his "Mammals of Australia, Illustrated by Miss Harriet Scott and Mrs. H. Forde, for the Council of Education, with a short account of all the species hitherto described, by Gerard Krefft."

In 1865, the husband of the younger sister, Mr Edward Forde, was appointed to the charge of a party despatched by the Government to survey the Lower Darling. Mrs. Forde, who accompanied him, took advantage of the life in camp to observe, collect and paint the plants new to her. The expedition had a tragic end, both the Fordes were seized with typhoid fever, from which the husband failed to recover. On her return to Sydney the widow placed her collections in the hands of Dr. Wools, who utilised the material in his "Plants of the Darling" (1867). Mrs. Forde's elder sister, who married a medical practitioner, predeceased her in 1907.

Mr. J. H. Maiden has kindly assisted me with a few notes on our late fellow-member, Mr. William Forsyth, who was born near Crieff, Perthshire, Scotland, 5th October, 1864; and came of good farming stock. He passed away suddenly on the 14th September last. He had been Overseer of the Centennial Park for the last nineteen years, and the fine state of the Park, as we see it to-day, is largely owing to his labours. He was an able horticulturist and an excellent botanist.

At the last Commemoration of the University of Sydney the degree of B.A. was conferred upon him, at the age of 45 years. He had been an evening student, and it is feared that incessant study, after his daily duties in connection with the Park, injured his health.

He was a quiet student, reserved and shunning publicity he rarely attended any gathering. He was, however, present at the meeting of this Society held previous to his death, and since he had completed his University course he expressed his intention of regularly attending our meetings for the future.

He had an excellent knowledge of the Flora of New South Wales, and his loss is deplored by the Sydney botanists, as that of a valued colleague.

While these notes were being written the news reached me of the death in Launceston of Miss Mary Lodder on March 5th, 1911. She was the daughter of the late General Lodder, and spent most of her life at Ulverstone, a pretty seaside place in Northern Tasmania. Here she collected shells, and supplied rare species to conchologists. Reference to her work is frequent in Australian literature on the mollusca. Of late years she had resided in Launceston, and devoted much time and attention to the welfare of the Launceston Museum.

As a change from the usual procedure of papers only, Mr. Fletcher initiated a discussion at the Monthly Meeting in May, on Jordan's law of geminate species, as illustrated by Australian conditions. The subject was carefully considered and evoked much interest. On the whole it was not regarded as applicable either by botanists or zoologists.

The more technical work of the monthly meetings was further relieved by lantern-lectures; one by Dr. Chapman on precipitins; another by Mr. Henry Deane, on the physiography, botany and geology of the desert country traversed by the Transcontinental Railway Survey between

Port Augusta and Kalgoorlie; and lastly by Mr. A R. M'Culloch, on the experiences of a naturalist in the New Hebrides.

In common with our fellow-subjects throughout the world, we deplored the death of his gracious Majesty King Edward VIIth. The expression of our sorrow was acknowledged by his Excellency the Governor in a letter read at the June Meeting. I have now to announce a second communication from His Excellency, conveying to the Society, from the Secretary of State, an expression of His Majesty the King's grateful thanks for your message of sympathy on the death of His late Majesty, King Edward VII.

Last year we noted with satisfaction that the Syme Prize for 1909 had been allotted to Dr. Jensen. Another of our members has since received this distinction, and we congratulated Dr. H. G. Chapman, upon whom the University of Melbourne bestowed this prize for Research work in natural science in 1910. His prize thesis is included in our last volume.

The honour conferred by the Sovereign upon Professor David was cordially appreciated by members of the Society. We are, moreover, gratified to learn that this popular Leader of Australian Science has been further honoured by a personal audience of the King, and that his University of Oxford has lately conferred upon him the degree of Doctor of Science.

Our published volume reflects but a part of the energy of our Society. It occurred to me to review the work that our members have performed elsewhere. But I find that their writings abroad far exceed the bulk of the official volume, and I have not ventured to enumerate such papers. I cannot refrain, however, from noticing an admirable memoir from the pen of one who commenced his studies in our serial, "The early development of the Marsupialia, with special reference to the Native Cat (*Dasyurus viverrinus*)" * by Dr.

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* Quarterly Journal of Microscopical Science, lvi., pt. i., 1910.

J. P. Hill. The process of cleavage, the formation of the blastocyst, and the differentiation of the embryonal ectoderm are described in detail. Against the attack of Prof. Hubrecht, he defends the opinion that the ancestors of the mammals possessed large and heavily yoked eggs.

The Council received an invitation from the Australian Board of Missions to co-operate in pleading the cause of the aboriginals, from a humanitarian, from a social, and from a scientific standpoint. Mr. Garland, the Secretary and myself were appointed to represent the Society. A large deputation was sympathetically received by the Prime Minister on January 24th, 1911. He assured us that the Federal Government realised its responsibilities in this direction, and that the Blacks of the Northern Territory, now under the control of the Commonwealth, would be protected by special officers and reserves of land.

In Australia, as well as in Europe, attention continues to be focussed on Antarctic Exploration. Results from the Expedition of Sir Ernest Shackleton are gradually receiving literary garb. On his way south, Captain R. Scott and his staff received a cordial welcome, and a hearty God-speed in Sydney last year.

The next campaign is being planned by our old comrade and fellow-member, Dr. Douglas Mawson, who desires to organise an Australian Antarctic Expedition. His field will be the exploration of the coast of the Antarctic Continent west of Cape Adare. Important results for all branches of science are anticipated from his journey. We trust that the example of the Australasian Association for the Advancement of Science in offering support will be the means of despatching a well-equipped party.

For the scientific part of this Address I have chosen:—

A STUDY OF MARGINAL DRAINAGE.

Last year I took for the subject of my address the submarine slope of New South Wales and attempted to show that the abyss beyond the margin of the continent is a pressure-trough.

If it be really such and if it can be correlated with great earth-folds that swell in New Caledonia and New Zealand, then its effects should be discernible in the face of Australia.

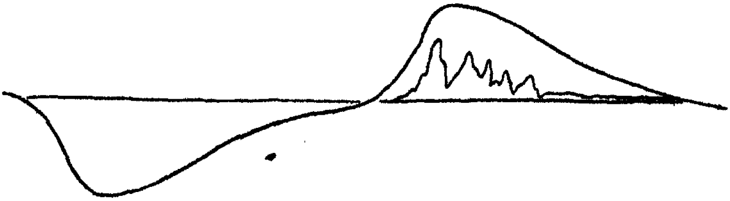

Fig. 1.—Diagram showing relation of the New Zealand ridge to the Ulladulla trough.

The term "fold" is here employed in the broad sense in which it is used by Professor C. Lapworth in his Presidential Address to the British Association.* From Hobart to Thursday Island the whole Pacific coast is acknowledged to have undergone recent and considerable subsidence. It is here suggested that this subsidence was effected by compressive movement, and that this is demonstrable by the inward crumpling of the land. The argument that follows seeks to show that the abnormal and distorted rivers, so peculiar a feature of this coast, are a consequence of this cause.

The best studied section of the East Australian coast, that through Sydney, exhibits a magnificent fold in which the coal seams rise in a wave curve in seventy miles from three thousand feet below the sea to three thousand feet above it.† As the coal plants grew in a great swamp, or series of swamps, so the coal beds must have extended horizontally during their formation. Being a fresh-water deposit, it was clearly above, though not much above, the level of the sea.

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* Report Brit. Assoc. Edinburgh, 1892, pp. 695-707.

† Carne, "Geology of Western Coalfields," 1908. Plan opp. p. 160.

Where one part of an original level sheet is found bent up above and another part bent down below the original plane of deposition, it is a sign of a powerful disturbing force. The valleys of the Blue Mountains and the coast at Sydney indicate the rise and fall of the fold to be so fresh as to be possibly still in progress.

Granting that a fold proves application of lateral pressure then the question occurs from which side of the fold did the pressure come, which was front, which back? Of a moving wave the steeper side appears in front and the longer slope behind.

When a stone is thrown into water, undulations recede from the impact, of these the nearer are of greater amplitude than the farther. Seawards of the Sydney-Blue Mountain fold lies the more gigantic flexure of the continental shelf and the abyss. On the principle of the wave of the greater amplitude being nearer to the impulse, these earth folds should be directed from the ocean landwards.

Mr. A. R. Daly* considers it "a fact that the thrust of mountain building has throughout the world been chiefly from the ocean towards the land." And Mr. Bailey Willis holds that, "There is abundant evidence . . . . . to prove that the tangential pressures exerted upon the continents proceed directly from the denser submarine masses."†

As detailed contour surveys in Australia are not available for study, the river systems of the East Coast are here examined. Rivers not only display the present levels, but also to some extent record past movements.

For the purpose of this discussion the drainage systems of continents may be contrasted as radial or marginal. Usually rivers rise in a central highland and radiate to opposite coasts; this may be described as "radial" drainage. A rarer case is where one coast receives the water from a narrow fringe, here called "marginal drainage," beyond which some large river conducts the rain-fall to another coast. Europe, Asia, Africa and the larger islands all belong to the first class, while examples of the second are to be found in the Americas and Australia.

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* Daly, Amer. Journ. Science, xxii., 1906, p.212.

† Willis, "Research in China," ii. 1907, p.117.

Professor Gregory writes*: "The whole of the northern, western and southern coasts of the [Australian] continent are, to use Professor Suess' term, of the 'Atlantic type.' The eastern coast of Queensland and New South Wales and apparently the eastern coast of Tasmania, are a variety of the Pacific type . . . . . in which the mountains and the trend of the rocks are parallel to the shore . . . . The eastern coast of Australia is, however, a less normal representative of the Pacific type than is the western coast of America."

So that in Australia where the Atlantic type of coast occurs there is radial drainage, but where the Pacific type prevails there is marginal drainage. In some districts the drainage is more intensely marginal than in others. This variation is associated with variation in the submarine contour opposite each. Where the continental shelf is broadest, there the rivers reach the deepest into the land, conversely the narrowest shelf fronts the shallowest watershed.

The greatest development of the continental shelf in Eastern Australia is attained about the tropic of Capricorn, there it extends for a breadth of eighty miles. This I regard as a fragment left of a wide shelf which formerly continued along the whole coast, but which in the south has been destroyed by the Thomson Deep and in the north by the Carpenter Deep. Sir J. Hector inferred, "That an extensive terrigenous shelf must indicate a long continued period of stability."† The tooth print of destruction is plain on the gnawed border of this continental shelf.

A great bight occurs between Fraser's Island and Swain's Reef. A very remarkable instance of the recent retreat of the continental shelf was here discovered by Capt. T. W. Sharp, of H.M.C.S. "Iris." Fraser's Island, Queensland, terminates to the northward in a prolongation called appropriately Break-Sea Spit. North of this, early navigators, among whom were Cook and Flinders, reported water of moderate depth. About 1869 this area was re-surveyed and accurately charted by the British Admiralty. Repairs required by a submarine telegraph cable induced Captain Sharp to re-examine this district in 1904. He found that from five to ten miles north of Break-Sea Spit the conformation of the sea-floor had entirely altered during the thirty-four years that had elapsed since the previous survey. Where his predecessors had found from twenty to thirty fathoms he measured from two to three hundred fathoms. The hundred fathom line had greatly changed both in direction and position. Captain Sharp, who has most kindly supplied me with this information and the accompanying map (Fig. 2), does not (as I am inclined to do) ascribe the alteration to a movement of the earth's crust. He believes it due to excavation of the sea floor by a powerful southerly-going current. To quote his letter to me, 6/2/'11, "I consider the bottom in this locality to be liable to variation at any time not by subsidence but by currents, as it is entirely sand."

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* Gregory, "Compendium of Geography," Australia I., 1907, p.65.

† Hector, Rep. Aust. Assoc. Adv. Sci. vii., 1898, p.670.

This change of the sea floor extends over more than a hundred square miles. Alterations in the neighbouring coast might have been expected to have accompanied such great changes under the sea. But nothing to correspond has been noticed. Yet Mr. A. Meston refers to an aboriginal tradition that a plateau on Fraser's Island near by suddenly sank into a large and deep lake.* Mr. W. C. Thomson states that "large masses of coral are found inland and near the mouth of the Boyne River [Port Curtis] overlaid by mud."† The

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* Meston, Fraser's Island, Parliamentary Reports Queensland, 1905, p.2.

† Thomson, Queensland Geographical Journal, xx., 1905, p.3.

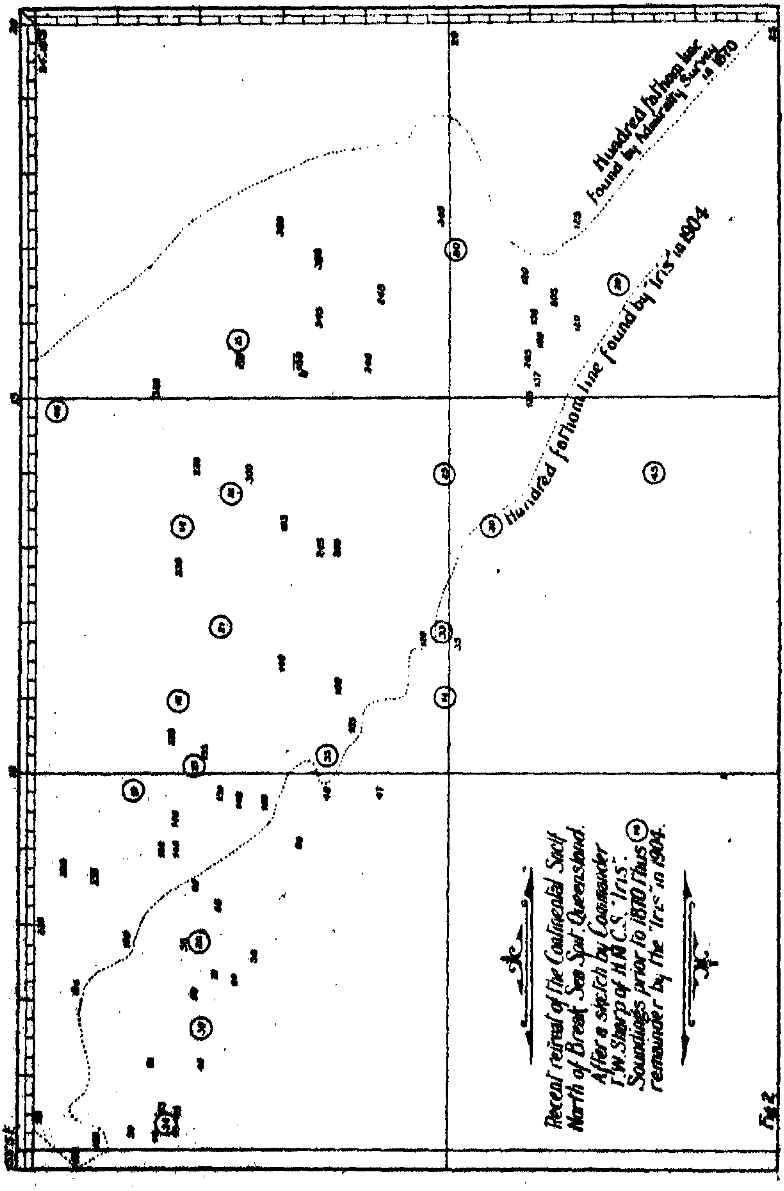
Hundred fathom line found by Admiralty Survey in 1870
Hundred fathom line found by "Iris" in 1904

Fig 2.

Recent retreat of the Continental Shelf North of Break Sea Spit, Queensland.
After a sketch by Commander F. W. Sharp of H.M.C.S. "Iris."
Soundings prior to 1870 thus
remainder by the "Iris" in 1904.

Marine Plains of Curtis Island are considered by residents to show a recent elevation.*

Though the Carpenter Deep extends downwards to 2450 fathoms, it is shown by the temperature soundings of the "Challenger" to be an enclosed basin of the Mediterranean type up to the level of 1300 fathoms. A ridge, yet unsurveyed, evidently runs eastwards from the Great Barrier Reef, parting the Thomson from the Carpenter Deep. It is here proposed to name this the Capricorn Ridge.

Eastern Australia is regarded by Mr. E. C. Andrews† as a "geographical unity" whose salient feature is a simple convexly curved coast. From this he deduced that movements would proceed from the land seawards. That unity appears to me to be divisible into halves, one of which is dominated by the Carpenter; the other by the Thomson Deep; the former being the younger and more active depression. So I should interpret the convex curve of Andrews as composed of two straight or *concave* lines, according to the depth of the submarine contour level selected. One of these is inter-tropical, the other extra-tropical and each again consists of series of smaller concavities.

The longest rivers of Eastern Australia, the Fitzroy and the Burdekin, occur opposite the broadest expanse of the shelf. I suggest that *the breadth of the shelf has preserved the length of these rivers* and presents it as a submarine buttress maintaining a buttressed area. (Fig. 3.) Probably this part of the shelf continues to exist rather from the avoidance than from the resistance of pressure. Festoons of islands and a dissected coast indicate that subsidence has occurred. So that the escape from pressure, even within this broadest shelf has been partial, not complete. The outline of the shelf and the islands that it carries shew that it cannot be an amalgamated delta and thus the consequence rather than the cause of the rivers.

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* Andrews, These Proceedings, xxvii., 1902, p.153.
† Andrews, Proc. Roy. Soc. N. S. Wales, xliv., 1910 (1911), p.462.

Protected by their submarine buttress, the Fitzroy and the Burdekin more nearly represent primitive radial drainage than any other Australian stream flowing into the

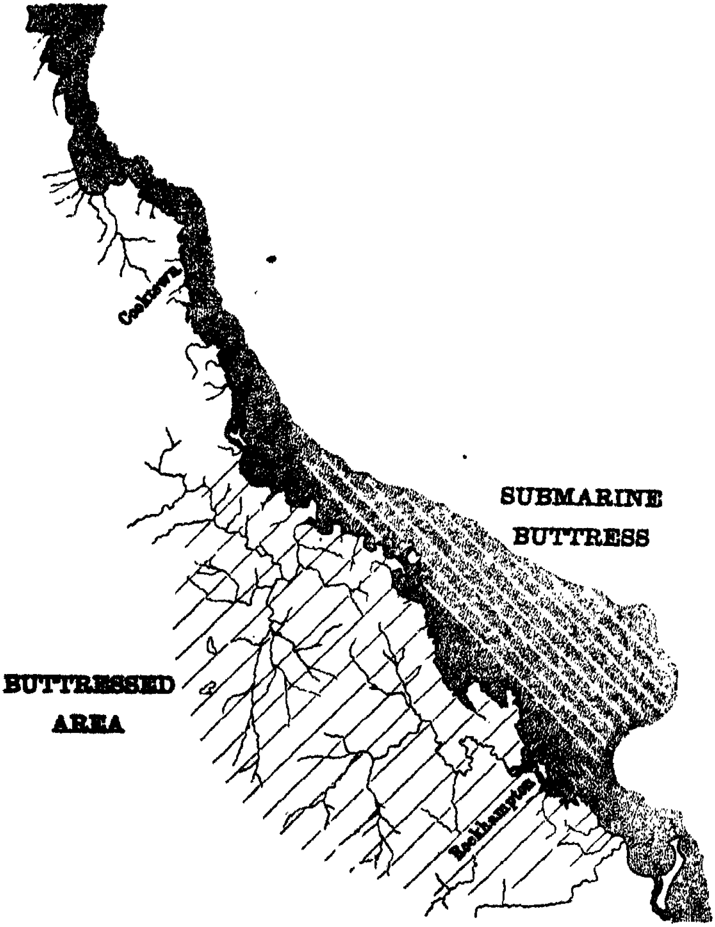

Fig. 3.—Coast of Queensland, North of Wide Bay, showing the relation between the old, long rivers and broad shelf in the south; and the new, short rivers and narrow shelf in the north.

Pacific. The plain on which they rise is here claimed to be a relic of the old Tertiary peneplain of east Australia. As a geological monument a peneplain might be reasonably expected to outlast a mountain range, since it is safest from denudation.

Dr. R. L. Jack writes: "The divide between the waters falling into the Gulf of Carpentaria and others which flow to the south was quite imperceptible." And again, "The extreme horizontality of the surface is due to the fact that the almost horizontal beds of the 'desert sandstone' formation cover the district without interruption."*

Mr. E. C. Andrews, who has paid special consideration to the Tertiary peneplain, has kindly given me the following expression of his views:—"A short time ago, geologically speaking, no mountains existed along the whole eastern side of Australia. At that time a gently rolling plain dotted with moderately sized hills stretched from New Guinea to Tasmania. Then enormous deluges of lava covered much of this great plain of Eastern Australia. Afterwards came a revolution in the appearance of the plain. The earth was slowly forced up until it could no longer bear the strain and finally broke along a hundred lines running in north and south directions. Thus some blocks were forced high up to make mountain masses like Kosciusko, while others fell down alongside them for thousands of feet in terrace form, such as the Snowy Valley under Kosciusko at Jindabyne. Nevertheless, so slowly was this uplift carried out that many rivers were not even turned out of their ways by the formation thus of the mountains against their courses, but they actually cut their way down into the mountains as fast as the land rose against them. The Lower Hawkesbury is an example of such action."

The whole course of the Fitzroy and Burdekin is exceptional, showing the characters of age in infancy and the features of youthfulness in middle age. The peneplain on which they rise is old, the shelf on which they discharge is old, but the coastal ranges through which they cut their gorges are new. An exceptional history is required for these exceptional features and such I have endeavoured to supply. The fate that apparently overtook other streams, during the crumpling of the coast, of being broken in the middle and reversed threatened them also. But the partial protection of the submarine buttress rendered the attack less severe than it was either north or south. So these rivers survived as radials, but not without a hard struggle. The isolated sheets of alluvial deposited by the Fitzroy at Gogango and by the Burdekin above Mount Dalrymple, show where they staggered in their course. The gorges through which they pass, not at the commencement of their career like ordinary rivers, but towards their close, show where they were almost overpowered.

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* R. L. Jack, Queensland Parliamentary Papers, Report Transcontinental Railway, 1882, p. 16; and Coal Discoveries on the Flinders, 1888, p. 1.

It is submitted that a perfect correspondence is now shown between the age and the length of the rivers on the one hand and the opposite breadth of the shelf on the other. If movements of the land occurred as vertical uplifts or downthrows or as folding from the land seawards, such correspondence should be mere chance. But on the hypothesis of lateral pressure folding from the sea landwards, this correspondence is a natural consequence. It is therefore a strong argument in support of that explanation.

In contrast to the radial river running its course behind the shelter of a broad shelf, we will consider a great marginal stream unprotected within its narrow shelf. From Montagu Island east to the hundred fathom line is five miles. West from Montagu Island to the main divide is forty-five miles. Here we have the extreme of marginal drainage opposite the narrowest extreme of the continental shelf in New South Wales. A remarkable section is obtained by following the thirty-fifth parallel across the continent. Starting from Jervis Bay, after an ascent of seventy miles the Pacific watershed is passed at the hills above Lake George. Then descending along the Murrumbidgee the broad floor of the valley is traversed on which the Murray is twice crossed. Not until after six or seven hundred miles of travel is the opposite watershed gained at Mt. Lofty above Adelaide.

Perhaps the most interesting tale yet told of the physiography of New South Wales is the vivid story by Dr. Woolnough and Mr. T. G. Taylor* of how the Upper Shoalhaven River formerly flowed into the Wollondilly, thence into the Nepean and so into the Hawkesbury. Thus it reached the sea after following a course of about a hundred and sixty miles, roughly parallel to the coast and distant from it about forty miles. A crisis in its history occurred. Not only did a pirate stream, the Lower Shoalhaven, behead the former Wollondilly, but a further capture of Wollondilly water is imminent in the near future. In the past the Moruya and the Tuross Rivers have each taken a length from the old river. No marginal stream could have the power to excavate and capture possessed by a radial hence the former must always fall a victim to the latter. These threats and captures are attempts and successes to proceed from marginal to radial drainage, to progress from the abnormal to the normal.

In the accompanying sketch (Fig. 4) the long valley of the Shoalhawke (to coin a convenient name by connecting the old source with the old mouth) is drawn as described in the memoir cited, but extended southward as recently suggested to me by Dr. Woolnough. It is clear that this river could not have pursued this eccentric course during the last peneplain period. For under peneplain conditions gravity would force a stream to base level by the shortest way. Through almost level country a river must take full advantage of what little slope it has or it would stagnate. A river flowing, for instance, into the Gulf of Carpentaria could not afford to waste its fall by setting a course parallel to the coast.

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* These Proceedings, xxxi., 1906, pp.546-554.

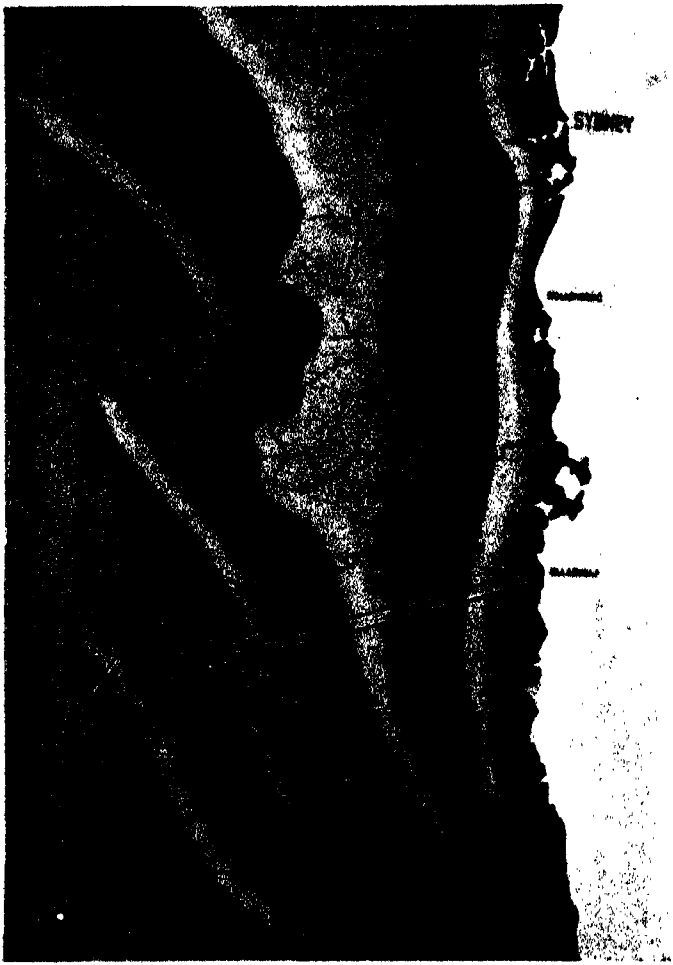

Fig. 4.—Restoration of the "Shoalhawke" valley, bounded by the littoral ridge which controlled the former drainage system. Young streams cutting across that ridge are now dismembering the old marginal into new subradial valleys. Beyond the Pacific watershed, the arrow overlies an area of parallel hills and valleys compressed from east to west.

So in the peneplain epoch, marginal streams being impossible, only radial streams existed. If a simple vertical uplift of the peneplain occurred the rivers would have deepened but not deviated from their former channel. Therefore, the Shoalhawke could not have held its present position in peneplain times, since when the drainage of its area must have radically changed. The long northerly run of that river suggests to me that it was banked off from the ocean by the rise of an intervening ridge. This view finds support in the record by Dr. H. I. Jensen[*] of a monoclinal fold not older than the Pliocene in the Sassafras tableland. I suggest that a fold, rolling before it the bed of a former radial river, commenced at the Kosciusko upland and crept northward till stayed by the resistance of the buttress of the Hunter. Subsequent denudation and deformation have altered this littoral ridge, but the stream it formed still bears the imprint of its guidance.

At present the old Shoalhawke valley is fulfilling its natural destiny of being cut across by subsequent streams into blocks of secondary radial drainage. *Since a valley parallel to the sea opposes the efforts of water to escape to base level by the shortest way, it could be but a temporary phase in physiography.* Hence the old Shoalhawke valley itself must be of but slight geological antiquity.

Mr. E. C. Andrews has already pointed out that the Colo, although the smaller stream, should be regarded as the original trunk of the Hawkesbury complex. He considered[†] that its subsequent, a southern tributary, started on a marauding expedition capturing stream after stream until it obtained the Upper Shoalhaven. On the contrary, it is now suggested that the Hawkesbury did not *grow out* of the Colo, but was *driven in* to it. If it were so, then the present course of the river would be the ultimate result of abyssal movements.

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[*] Jensen, Proc. Roy. Soc. N. S. Wales, xliii., 1908, p.302.

[†] Andrews, "Introduc. Phys. Geography N. S. Wales," 1909, p.40.

The lower or tidal portion of the Hawkesbury River reaches the sea through a magnificent gorge, eight hundred feet deep. If this gorge were artificially filled up, the river thus dammed back could not overflow the obstacle, because before the flood had risen to the necessary height it would escape as a by-wash into Port Jackson by the Parramatta River. These levels suggest that the lower Hawkesbury is older than the height of the country traversed by it. The great depth, two hundred feet below sea level, of the drowned valley at the Hawkesbury Railway Bridge is accepted as a proof of considerable recent subsidence. But surely the height of the land cut through by the river is an equally positive proof of a penultimate movement of slow elevation recognised by Mr. Andrews* during which the river sank its channel through the rising ground. On a smaller scale the Parramatta repeats the same history, cutting through high ground as it passes Sydney.

An inner fold is suggested by the Nepean Gorge which "is due to the river gradually eating down its bed as the Blue Mountain scarp was elevated."† The gravel bed at Penrith, descending almost to sea level, might represent the trough between these two folds. If these deductions be allowed we find that ridges parallel to the coast have gradually risen and after being sawn across by the streams they opposed, the outer one subsided. These movements agree with the theory of pressure forcing landwards from the sea. The coastal range along Illawarra and southwards probably rose with the Lower Hawkesbury country.

Inland from the Upper Shoalhaven is a succession of parallel rivers and ranges running in a northerly and southerly direction. This tract appears to have received a push from the direction of the Ulladulla trough (Fig. 4). The

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* Andrews, These Proceedings xxviii., 1903 (1904), p.812.

† Taylor, These Proceedings, xxxii., 1907, p.328.

Murrumbidgee after receiving the drainage of this area encounters the Black Andrew Range, through which it has carved a great gorge at Burrinjuck.* Following the principle already advanced in the case of the Hawkesbury Gorge at Wiseman's Ferry, the Burrinjuck may be cited as evidence that the hill gradually rose against the river. Troughs would be produced by the elevation of folds parallel to the Black Andrew Range. The Rev. W. B. Clarke† insisted emphatically on the folding which has occurred in this area. He wrote, "The parallelism of the ranges and rivers, including the Shoalhaven, the Queanbeyan, the Murrumbidgee, the Coodradigbee, and the Tumut, all of which have a general trend from S. to N., between the parallels of 35 degrees and 36 degrees S., is not without a significant cause;" and again, "The Murrumbidgee runs in the straight course it pursues from above Bullanamang to below Michelago in a synclinal depression." Though at first sight these streams might appear to lie in valleys of erosion guided by choice of softer rock, it is suggested that original fold valleys were here deepened by erosion.

Apparently unacquainted with the studies of his predecessor, Mr. T. G. Taylor, half a century afterwards, came to the same conclusion. He writes, "Indeed the Goodradigbee, Tumut and Adelong Rivers, may all have been determined by folding or faulting in accord with the general north-south trend of the rocks in this area. The sudden bend of the Murrumbidgee to the west, near Yass, probably indicates where the river leaves the uneasy crust of the Monaro Highlands for the comparative solidity of the western plains."‡

The capture of the head of the Snowy River by the Murrumbidgee, described in such admirable detail by Taylor, appears to be of a different order of events to the capture by the Lower Shoalhaven of the Upper Shoalhaven. In the latter case a high level stream was tapped by a low level stream and then the old river, as far as its lower portion was concerned, just bled to death. But the Murrumbidgee drained the old Snowy upwards and backwards through one of its sources while another source, though eventually intercepted, still maintains the original direction. Undercutting at static conditions would not effect this.

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* Süssmilch, Journ. Roy. Soc. N.S.W., xliii., 1909, Pl. x.

† Clarke, "Researches in the Southern Goldfields, 1860," pp. 73 and 81.

‡ Taylor, "Physiography of Federal Territory." Bull. vi., Bureau of Meteorology, 1910, p. 11.

Can we interpret the Murrumbidgee capture as due to the development of an earth fold that rocked the old river backwards for some sixty miles? Such a movement would empty of its stream the large but untenanted valley south of Cooma, the Great Monaro Valley of Taylor, to which Mr. Süssmilch first called attention. Since the Murrumbidgee above Cooma still keeps to the bed by which it used to join the Snowy I suggest that a movement which screwed up the valleys till the watershed shifted sixty miles south, pressed down the old eastern Snowy source till at Tharwa it ran backwards to the Murrumbidgee and also pressed the old western source near Yarrangobilly up to flow as a rejuvenated river. It is likely that the two sources were originally of about the same altitude. Such a movement seems of more recent date than a fold which guided the Shoalhawke (and that in turn to be older than another fold of which Jervis Bay may be a vestige.

Mr. L. F. Harper has described the successive shifting eastwards and lowering of the channel of the Upper Murrumbidgee.* This account is suggestive of an undulatory movement of pliant folds rather than the breaking, faulting and tilting of a series of stiff blocks figured by Taylor. It re-calls the classic instance of the bed at Lapstone Hill, whose river formerly drained the high quartz-felsite range towards Wombeyan. The bed of this old stream shared in the folding of the Sydney-Blue Mountain area and has thus been tossed from the bottom of its valley high on the shoulder of the mountain, where it lies athwart and cleft by the present lines of drainage.*

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* Harper, Rec. Geol. Survey N. S. Wales ix., 1909, p.5

East of the Murrumbidgee area Mr. T. G. Taylor records with emphasis "positive evidence of the *Tertiary folding* into which the Cullarin or Lake George Fault has passed at its southern extremity."† South of Lake George the Molonglo River has sawn across this elevation as it slowly rose against it.

The littoral ridge of southern New South Wales fails on approaching the Hunter valley. In the Hawkesbury Estuary the latest movement was a subsidence of two hundred feet preceded by an elevation of a thousand feet. Further north in the more stable area, Prof. David thus records the latest movements, "The apex of the delta near West Maitland rose slowly to the amount of about fifteen feet, while a downward movement was still in progress in the neighbourhood of the present ocean beach between Stockton and Port Stephens."‡

Opposite Newcastle the continental shelf (Fig. 5) reaches its maximum breadth in this State of thirty-four miles, yet is narrow in comparison with that of the tropics and has probably suffered considerable curtailment. Regarding it as a submarine buttress, its shelter affords a radial valley reaching further back from the sea, namely a hundred and thirty miles, than any other coastal river in New South Wales. Following the argument advanced for the Burdekin and the Fitzroy, it is now suggested that the Hunter represents an original radial stream, a survivor of the peneplain epoch. That it has been but partially protected by a lesser buttress, and its head has been withdrawn from the western peneplain in which a larger buttress would have allowed it to rest. Yet it now rises at an elevation lower than the source of any other river of the State. This interesting feature has been described by Mr. T. G. Taylor as the "Cassilis Geocol."* He

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* Carne, "Geology of Western Coalfield," 1908, p. 18.

† Taylor, These Proceedings, xxxii., 1907, p. 329.

‡ David, "Geology of Hunter River Coal Measures," 1907, p. 340.

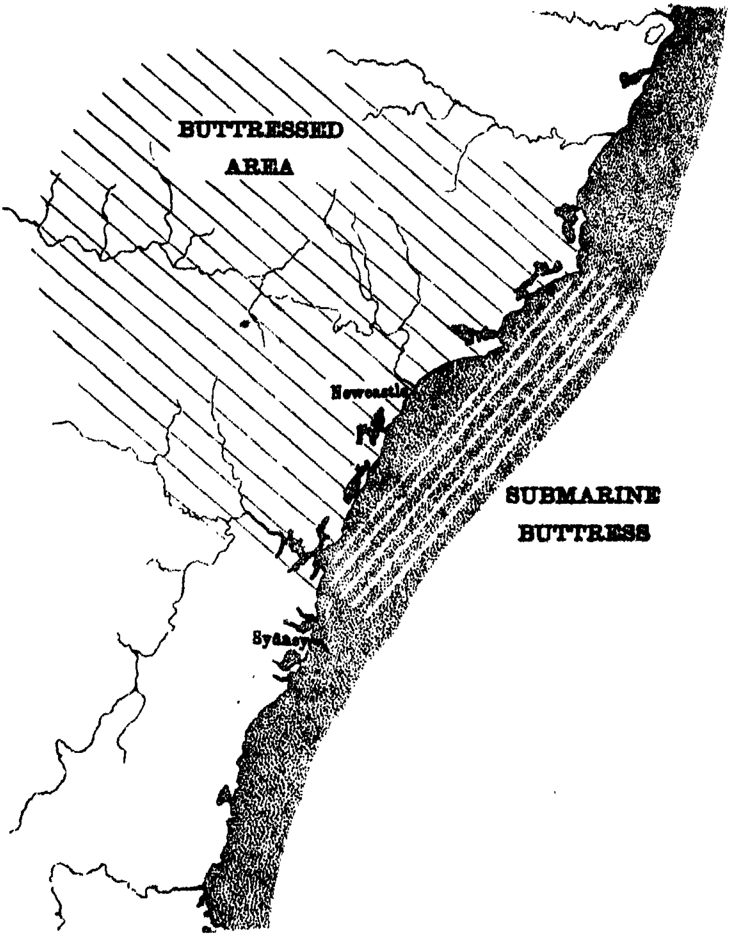

Fig. 5.—Coast of New South Wales between Jervis Bay and Port Macquarie, showing the correspondence between the old, long river and the broader shelf, and the young, short river and narrower shelf.

however regarded it as a shifting westwards of the Main Divide. On the hypothesis now put forward it would be considered that a general eastward shifting of the Divide here lagged behind. In other words, it is nearer to the condition prevailing at the close of the last geological cycle than any other coastal river of New South Wales.

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* Taylor, These Proceedings, xxxi., 1906, p.518.

Professor David has shown* that prior to the outpourings of basalt, a former river had a gentler gradient than its present representative a tributary of the Dumaresq River. The fact would be in agreement with the supposition that at the date of the basalt extrusion the New England Plateau had not attained its present altitude.

Dr. W. G. Woolnough has generously given me the following unpublished observations on the relics he has detected of another great marginal valley. "The Lower Macleay is very nearly north and south and lies *behind* the high rock mass of Trial Bay and Smoky Cape. Thence southwards the broad valley-like structure is breached on the eastern side and remnants only of the eastern lip remain in the form of headlands like Point Plomer and Crescent Head, and the high lands behind the latter. The dead water of the Belmore is continuous with that of Maria River and boats have been taken by this route from the Macleay watershed to that of the Hastings. The southward trend of the valley (?) is continued through Lake Innes, again cut off by high rock masses from the sea. Though Lake Innes is not continuous with Queen's Lake, there is only a low divide between them, probably formed of recent sediments (information received). Thus we come to the chain of lakes and creeks forming the Camden Haven system. There is a marshy belt joining the southern end of Watson Taylor Lake waters with Cattai Creek, a branch of the Manning. Hence the trend of the valley is *behind* the rocky masses of Mitchell and Oxley Islands and through the marshes to Wallis Lake. The divide between this and Smith's Lake is low and narrow, and thus we enter the Smith's Lake-Myall-Port Stephens system which brings us down *mostly behind rocky highlands* to Stockton Beach. A glance at a map of the coast shows that this particular section of it protrudes as a bulge beyond the general line of the shore to the north and south, and it is in this section only that I recognize at all clearly the features of valley formation described above. Certain gravel deposits, *e.g.*, on the Lower Manning require careful investigation. At the present stage all I do is to throw out the suggestion of a very ancient and highly mature coastal valley parallel to our coast line, of which the feature I have sketched above is the imperfect fragment."

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* David, "Geology of Vegetable Creek," 1887, p.60.

The projection from the main coast line which Dr. Woolnough describes above is repeated on a small scale by the headlands of Jervis Bay. In this connection it is interesting to note that Mr. Taylor drew attention to the low land within and the possibility of that area being a segment of a former valley* Perhaps the last stage in dissolution of a marginal valley is represented by Jervis Bay.

The process lately commenced in the case of the Shoalhawke of being broken into lengths by cross streams, the inevitable doom of the marginal, has advanced in the Macleay-Port Stephens Valley so far as to almost obliterate its course. The longer time required for its greater denudation indicates the antiquity of the Northern valley. We have here also a suggestion of the existence of considerable land to seaward which has since disappeared.

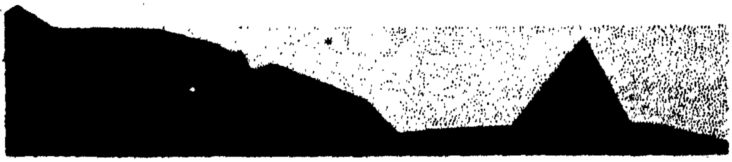

Fig. 6.—Profile from Mount Warning on the left, by way of Southport, to a point 28° 16′ S. lat., 155° 36′ E. long., and thence to 28° 52′ S. lat., 156° 11′ E. long., showing the Britannia Ridge rising to 220 fathoms, from a depth, on the west of 2,650 fathoms, and, on the east, of 2,832 fathoms.

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* Taylor, "Physiography of Federal Territory," 1910, p.11.

About a hundred and twenty miles east of Cape Byron lies a meridional ridge nearly fifty miles long, which if it has not yet received a name, might be called the "Britannia Ridge." It was discovered by Mr. Peake when the "Britannia" was surveying a track for the Pacific telegraph cable in May, 1901.* Out of a depth of 2500 fathoms it suddenly rises to within 250 fathoms of the surface. In other words it towers up some fourteen thousand feet from the abyss (Fig. 6). Possibly it represents a fold emerging and advancing upon the continent, an ultimate consequence of which might be the formation of a river of the Shoalhaven type.†

Of South Queensland Dr. H. I. Jensen‡ writes, "A somewhat recent elevatory movement in part of this area has effected certain changes in the drainage . . . . It is evident that the Brisbane River is a fairly young stream as regards its lower courses. . . . The Teviot Valley is mature except for a small part . . . . where it flows through hilly country, and I consider this region to have been slowly and recently elevated, river-erosion having kept pace with elevation."

Dr. R. L. Jack considered§ that the Brisbane River first poured its waters to the west and "took the course now followed by Gowrie Creek and the heads of the Condamine." Subsequent elevation of the Toowoomba Range turned the river into the Pacific; it probably flowed between Mount Gravatt and Mount Cotton south of its present bed. Finally in late Tertiary times other movements compelled its removal to the present situation.

An area of intensely marginal drainage occurs in North Queensland. From Townsville to Cooktown new short rivers pour into the ocean from a lofty coastal range. Immediately south of Cooktown the western waters approach to within a few miles of the Pacific, while the eastern streams are a series of cataracts, whose falls-line almost touches salt water. The youthfulness of these streams implies a corresponding youthfulness for the range which bears them. A recent capture of the Mitchell by the Barron was suggested by Mr T. G. Taylor and myself.* Details of this capture have since been published by Mr. W. Poole and are significant of recent movement.†

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* List of Ocean Depths, Hydrographic Dept., No. 183, 1902, pp.26-28.

† This ridge is shown in Prof. Marshall's map Aust. Assoc. Adv. Sci. xii., 1910, opp. p. 450.

‡ Jensen, These Proceedings, xxxiv., 1909, p.75.

§ Jack, Lecture reported in the "Brisbane Telegraph," 22/5/94.

The Great Barrier Reef, whose features show vast and recent subsidence, here faces a range apparently of considerable and recent elevation. The combination suggests powerful folding, recent or still in progress, carrying the reef down in the trough and the range up on the crest.

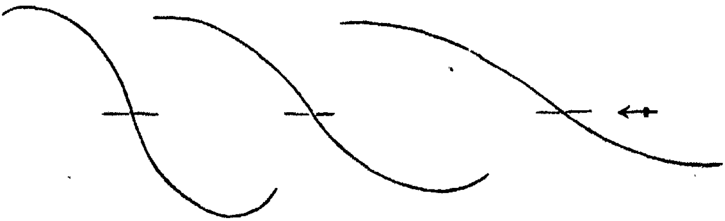

Fig. 7.—Diagram of a progressive fold.

The abrupt truncation of the meridional coast line at Cape Melville seems as if a whole coast range thence to Cape York might have broken away and slipped into the abyss. In this connection it may be recalled that Dr. Jack has described‡ and illustrated a great precretaceous dislocation on the head waters of the Kennedy River running north towards Princess Charlotte Bay.

In conclusion, it is suggested that the last geological cycle culminated at some post-miocene date with the reduction to a peneplain of most of Eastern Australia. Since a marginal river would lack the requisite slope to flow or carve on a peneplain, those were the days of radial drainage; when such a river as the Hunter might perhaps have risen at Cobar, and a river in the place of the Shoalhaven might possibly have run from Forbes. The coast would have extended then for some distance seawards of the present position. The Thomson and the Carpenter Deeps, though already in existence, had not attained their present depth or breadth and had lapsed into a state of inactivity.

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* H. and T., Rept. xii., Aust. Assoc. Adv. Sci., 1908, p.411.

† Poole, Rept. xiii., Aust. Assoc. Adv. Sci., 1910, p.316.

‡ Jack, Queensland Parliamentary Papers, Report on the Little River Coalfield, 1882.

A new cycle, the present, was inaugurated by the development of energy in the Thomson and Carpenter Deeps. "The master movements are," say Chamberlin and Salisbury, 'the sinking of the ocean-basins."* A strip of unsunken shelf off Cape Capricorn now lies wedged between the peripheries of the two ocean basins. Only at this corner has radial drainage survived. Within its range of action each deep has replaced radial by marginal rivers. Undulations (Fig. 8) pulsating from these abysses are considered to have broken back the coast line and ridged up ranges in the coastal districts of New South Wales and Queensland respectively. The drainage systems of the preceding peneplains were thereby broken, their upper waters being reversed and directed to another coast and their lower portions being re-

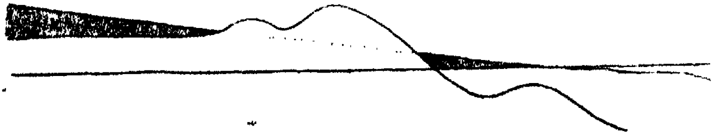

Fig. 8.—Diagram of transition from radial to marginal drainage. In the back ground the former peneplain is represented as extending further seaward than the present land and as continuing in a broad continental shelf. Recent folding is shown as having crumpled and sunk the former shelf and shore, and as having intercepted former streams by a littoral ridge. *Former rivers now reversed are supposed to be eroding the inner portion of the peneplain.*

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* Chamberlin and Salisbury: Geology, i., 1904, p.520.

formed to constitute the existing coastal rivers. Perhaps some large estuaries of small streams relate to the reception of greater radial rivers cut off recently. By rapid elevation of intervening ridges, some streams were trapped and forced into lengthy and roundabout courses. These are now gradually escaping from their bondage, and cutting more direct channels to the sea.

If in the future there should be a long period without earth movements, it seems reasonable to expect that the cycle will run its course, that the crooked rivers will gain a straighter way to the sea, and that their head waters will reach further back into the interior. But the excavation now being performed by the western rivers would prevent the coastal streams from extending as far back as I assume that they did at the conclusion of the previous cycle.

The ultimate cause of these earth-movements is beyond the limits of this address. Contraction of the outer crust by secular cooling has been generally accepted as an explanation. Lately Professor Chamberlin has suggested that periodic compressive movements might be due to a shrinkage of the centrosphere and not the lithosphere. Still more recently Dr. Bailey Willis has advanced the hypothesis that such movements had their origin in the tendency of the heavier sub-oceanic segments of the earth to spread and underthrust the margins of the continents.

SUMMARY.

Last year's consideration of the deep abyss, described as bordering this part of the continent, concluded with the hypothesis that it represented a pressure-trough. In support, it was argued that its configuration, and certain features of New Zealand and New Caledonia, whence the pressure was supposed to have come, were in conformity.

Such conditions should leave signs not only in the direction whence pressure came, but also in the direction upon which pressure leaned, namely, the East Coast of Australia It is now advanced that the crooked and abnormal rivers, so peculiar a feature of this coast, are a consequence of that cause.

Previous to the present cycle, that of Mt. Kosciusko, it is believed by geologists that a great peneplain extended from New Guinea, in the north, to Tasmania, in the south. Probably this peneplain extended eastwards beyond the limit of the present coast, and was continued seawards by a broad continental shelf. Probably also the ocean eastwards was then shallower and narrower than to-day.

The theory is now advanced that the present cycle commenced by the sinking of the ocean-floor, and by pressure upon the border of the continent. In the zone of compression, folding on a large scale ensued, by which the continental shelf was depressed, and the coastal range elevated, simultaneously.

In support, it is demonstrated that harmony exists between the margin of the continental shelf on the one side, and the line of the Pacific watershed on the other. Where the margin of the shelf approaches the coast, so does the divide Where the divide retreats from the shoreline, so does the margin of the shelf. From this it is inferred that a broad shelf serves as a buttress to that portion of the continent that lies behind it. Sheltered by this buttress, radial rivers persist as relics from the peneplain-epoch. As an example, attention is directed to the Burdekin and Fitzroy Rivers, the longest rivers of Eastern Australia, which discharge upon the broadest shelf. In New South Wales even the broadest shelf is narrow, namely, that off Newcastle. But here our rule holds good, for narrow though it be, that shelf protects the longest river, the best example of a radial river, in the State. The Hunter is claimed accordingly as a survivor of the radial rivers that must have prevailed in peneplain-times.

To show that the continental shelf is still being diminished, a remarkable instance is furnished by Captain Sharp, of how the shelf has retreated from 5-10 miles within forty years, near Break Sea Spit. The coastal ranges and the streams they bear, both in Queensland and in New South Wales, are regarded as very new geologically.

A peculiar feature of many rivers of our Pacific slope is that, for part of their course, they run in valleys parallel to the shore. Then they are apt to break away and run direct to the sea.

Of where and what were the rivers of the preceding cycle, the peneplain-times, we have no record. But it is obvious that no peneplain could have carried such crooked rivers as the Clarence or the Shoalhaven run to-day. Of necessity the peneplain-rivers were longer, slower, and straighter than these. They had no fall to waste in that long journey to the sea. On a peneplain, circuitous courses would mean final stagnation.

The problem is: how were those peneplain-rivers succeeded by an entirely diverse scheme of drainage. The explanation now offered is that these crooked rivers lie in a zone of compression. That movements from the pressure-trough threw the coastal area into irregular folds. That these broke and caught the radial rivers, which, turning aside, flowed along their furrows. Then at once denudation played on elevation. Rain and river attacked the higher land and broke it down. At every opportunity the river burst through the obstacle which held it back from the shortest way to the sea. As denudation progressed, the river broke through again and again, until radial drainage was restored. Finally the old channel, chopped in lengths by cross-streams, appears as an empty river-bed. Every stage in this performance is illustrated by the rivers of New South Wales. There is the Upper Murrumbidgee, newly tilted by earth-movements from the Snowy River. Then there is the Shoalhaven River, both as it was when it ran from the present source of the Tuross to Broken Bay, and as we find it now. There is the old valley, discovered by Dr. Woolnough, running from Smoky Cape to Port Stephens; and, lastly, the fragment represented by Jervis Bay.

It is clear that as these great meridional valleys, marginal to the coast, are now undergoing rapid disintegration by the ordinary agents of denudation, that they cannot have endured such attack for long. Consequently these valleys themselves are geologically recent. The same conclusion is thus reached as that arrived at through considering that these rivers could not have existed under peneplain-conditions, and are, consequently, far younger than the peneplain-period.

In my last words from this Chair, let me hope that energy and enthusiasm may never fail you, but may lead you to new knowledge by paths yet unseen, untrod, so—

FLOREAT SOCIETAS LINNEANA

EXPLANATION OF PLATE.

Plate i.

Transformation of drainage from radial to marginal. Above, a scheme of peneplain-rivers, slow in current, direct in course, reaching the sea square to the coast. Below, a scheme of marginal drainage, such as is developed on the East Australian coast. Here folds, newly arisen, have interrupted the radials of the previous cycle, and forced them to flow along the hollows. In course of time, these folds are destined to be breached by subsequent streams, thus restoring a radial system, though one less perfect than that of the previous cycle.

Mr J. H. Campbell, Hon. Treasurer, presented the balance sheet for the year 1910, duly signed by the Auditor, Mr. F. H. Rayment, F.C.P.A., Incorporated Accountant; and he moved that it be received and adopted, which was carried unanimously. The Society's income for the year ended December 31st, 1910, was £1,039 0s 7d.; the expenditure £1,019 10s. 6d.; with a debit balance of £35 13s. 4d. from the previous year, leaving a credit balance of £16 3s. 3d. The income of the Bacteriological Department was £544 16s. 8d.; and the expenditure £477 13s. 3d.; with a credit balance of £522 0s. 5d. (less £500 since invested) from the previous year, leaving a credit balance of £89 3s. 10d. Macleay Fellowships' Account: income £1,504 5s. 5d.; expenditure, £1,101 15s.; leaving a credit balance of £569 3s. 9d. to be carried to Capital Account.

No nomination of other Candidates having been received, the President declared the following elections for the current Session to have been duly made:—

PRESIDENT: W. W. Froggatt, F.L.S.

MEMBERS OF COUNCIL (to fill six vacancies): Prof. T. W. E. David, B.A., F.R.S., C.M.G., Henry Deane, M.A., F.L.S., &c., W. S. Dun, James R. Garland, M.A., Prof. W. A. Haswell, D.Sc., F.R.S., J. H. Maiden, F.L.S., &c.

AUDITOR: F. H. Rayment, F.C.P.A.

On the motion of Mr. Andrews, seconded by Mr. Süssmilch a very cordial vote of thanks was accorded to the retiring President, by acclamation.

The Linnean Society of New South Wales.

GENERAL ACCOUNT.

Balance Sheet at 31st December, 1910.

LIABILITIES.	£	s	d
Capital: Amount received from Sir William Macleay during his lifetime	14,000	0	0
Further Sum bequeathed by his Will £6,000, less Probate Duty, £300	5,700	0	0
	£19,700	0	0
Bookbinding A/c	16	16	0
	£19,716	16	0

ASSETS.	£	s	d	£	s	d
Investments: Loans on Mortgage...	14,700	0	0			
New South Wales inscribed 3¼% Stock ...	5,000	0	0	19,700	0	0
Income A/c at 31st December, 1910... ...				16	3	3
Commercial Banking Co. of Sydney, Ltd.					12	9
				£19,716	16	0

Audited and found correct. Securities produced.

F. H. RAYMENT, F.C.P.A., Auditor.

Sydney, 14th March, 1911.

J. H. CAMPBELL, Hon. Treasurer.

INCOME ACCOUNT, year ended 31st December, 1910.

Dr. | Cr.

Dr.	£	s	d	£	s	d
To Balance from 1909 ...				35	13	4
,, Salaries and Wages ...				473	13	4
,, Printing (Publications)	328	16	0			
,, Illustrations	80	8	[illegible]			
				409	4	9
,, Ground Rent	48	0	0			
,, Rates	14	19	4			
,, Insurance	7	13	8			
				70	13	0
,, Postage, Telegrams, Advertising & Petties	41	8	5			
,, Audit Fee (proportion of)	1	15	0			
,, Printing (sundries), Stationery, &c.	5	9	0			
,, Maintenance Fee, Sir Wm. Macleay's Grave	1	10	0			
,, Expenses...	4	10	0			
,, Bank Charges		17	0			
				55	9	5
,, Bookbinding A/c				10	10	0
				£1055	3	10

Cr.	£	s	d	£	s	d
By Subscriptions—						
Arrears...	16	15	0			
1910	114	9	0			
In advance	3	3	0			
				134	7	0
,, Entrance Fees				10	10	0
,, Interest on Investments				760	6	11
,, Sales (including 100 copies of Proceedings purchased by Government)				133	16	8
,, Balance to 1911...				16	3	3
				£1055	3	10

Audited and found correct. Securities produced.

F. H. Rayment, F.C.P.A., Auditor.

Sydney, 14*th March*, 1911.

J. H. Campbell, Hon. Treasurer.

BACTERIOLOGY ACCOUNT.

Balance Sheet at 31st December, 1910.

Liabilities.	£	s	d
Capital: Amount bequeathed by Sir William Macleay, £12,000, less Probate Duty £600...	11,400	0	0
Accumulated Interest ordered by Council to be added to Capital	1,600	0	0
Interest invested	850	0	0
	13,850	0	0
Income Account at 31st Dec., 1910	89	3	10
Cash:			
	£13,939	3	10

Assets.	£	s	d	£	s	d
Investments:						
Loan on Mortgage				13,350	0	0
Cash:						
New South Wales Inscribed 3½% Stock...				500	0	0
Commercial Banking Co.	81	13	10			
Government Sav. Bank	7	10	0			
				89	3	10
				£13,939	3	10

INCOME ACCOUNT, year ended 31st December, 1910.

Dr.	£	s	d	£	s	d
To Salary and Wages... ...	441	0	5			
,, Ground Rent	16	0	0			
,, Rates...	4	19	9			
,, Insurance	1	5	4			
,, Gas	5	5	3			
,, Journals and Printing	1	7	6			
,, Audit Fee (proportion of)	1	15	0			
,, Petty Cash	6	0	0			
				477	13	3
,, Accumulated Interest Invested...				500	0	0
,, Balance to 1911				89	3	10
				£1,066	17	1

Cr.	£	s	d	£	s
By Balance from 1909 ...				522	0
,, Interest on Investments				541	10
,, Tuition Fees	10	0	0		
,, Less Bacteriologist's Proportion	6	13	4		
				3	6	8
				£1,066	17	1

Audited and found correct. Securities produced.

F. H. Rayment, F.C.P.A., Auditor.

Sydney, 14th March, 1911.

J. H. Campbell, Hon. Treasurer.

LINNEAN MACLEAY FELLOWSHIPS' ACCOUNT

Balance Sheet at 31st December, 1910

LIABILITIES.

	£	s	d	£	s	d
Capital: Amount bequeathed by Sir William Macleay, £35,000, less £1,750 Probate Duty...				33,250	0	0
Balance from Income Account capitalised in terms of bequest or available for such purpose—						
To 31st Dec., 1909	£5,165	7	8			
At 31st Dec., 1910	569	3	9			
				5,734	11	5
				£38,984	11	5

ASSETS.

	£	s	d	£	s	d
Investments: Loan on Mortgage	33,250	0	0			
New South Wales Inscribed 3½% Stock...	5,500	0	0			
				38,750	0	0
Cash:						
Commercial Banking Co.				169	3	9
Savings Bank of N.S.W.				65	7	8
				£38,984	11	5

INCOME ACCOUNT, year ended 31st December, 1910.

Dr. Cr.

Dr.	£	s	d
To Salaries of Linnean Macleay Fellows	933	6	8
,, Audit Fee (proportion of)	1	15	0
,, Amount transferred to Capital A/c	569	3	9
	£1,504	5	5

Cr.	£	s	d
By Interest on Investments...	1,504	5	5
	£1,504	5	5

Audited and found correct. Securities produced.

F. H. Rayment, F.C.P.A., Auditor.

Sydney, 14*th March*, 1911.

J. H. Campbell, Hon. Treasurer.

ORDINARY MONTHLY MEETING.

March 29th, 1911.

Mr. W. W. Froggatt, F.L.S., President, in the Chair.

The Donations and Exchanges received since the previous Monthly Meeting (30th November, 1910), amounting to 31 Vols., 265 Parts or Nos., 56 Bulletins, 12 Reports, and 67 Pamphlets, received from 109 Societies, &c., and 2 Individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. D. G. Stead chronicled as an addition to the fish-fauna of New South Wales, the Sail-Fish, *Istiophorus gladius*, a specimen of which, 7 feet 6 inches in length, had been captured at Port Stephens during the month. A photograph of the specimen was shown, together with one of a much larger specimen recently caught at Fiji. He also exhibited a living immature example of the beautiful Butter-Fish, *Ephippus multifasciatus*.

Mr. North exhibited an adult male and female Stone Runner, *Ashbyia lovei* (Ashby), being the types of a recently described genus and species, from Leigh's Creek, South Australia. Mr. J. R. B. Love, its discoverer, remarks in writing to Mr. Ashby, "This bird inhabits the bare plains covered with small stones so characteristic of this country. I have not seen it on earthy salt-bush plains."

A NEW SMUT IN A NEW GENUS OF GRASS.

By D. McAlpine, Corresponding Member.

(Plate i.).

A grass was sent to me, in November, by Professor Ewart, which he determined to be a new genus, *Sarga*; and the ovaries were black and swollen, evidently owing to a smut. They contained a black powdery mass which stained the fingers, but without smell; and, on examination, this powder was found to be the spores of a smut. The specimen was from North-West Australia; and, in a recently published work on 'The Smuts of Australia,' it is remarked "In West Australia only those species are known, which attack cultivated crops, and those occurring on the native flora have yet to be discovered." There is no doubt but a rich harvest awaits the smut-collector in West Australia, and the present new species is the first of its kind.

Ustilago ewarti McAlp.

Sori in spikelets, forming a black compact mass, much swollen, at first enveloped by the firm wall of the ovary, ultimately bursting and allowing the black powdery spores to escape. Spores black in the mass, dark brown individually, globose, averaging 10-13 μ diam., occasionally ellipsoid (13 × 11 μ), densely covered with pointed spikes

Germination as in *Ustilago*.*

Hab. North-West Australia: Napier, Broome Bay; May, 1910 (Ewart).

On the one-flowered, hermaphrodite spikelets of *Sarga stipoidea* Ewart and White.

The basal portion of the long and twisted, persistent awn remains attached for some time to the smutted ovary.

If a transverse section of a smutted grain is made, the interior is seen to be filled with spores at different stages of maturity, intermixed with slender colourless fungus-filaments rounding off into spores at intervals or close together. The spores are at first small, ellipsoid becoming round, colourless, smooth and thick-walled Then of an olivaceous tint, passing into a golden-brown, with echinulate wall, and finally of a deep rich brown, with wall densely spiked.

Germination. —This took place in a hanging drop of tap-water, where a large proportion of the spores germinated, and the photographs were taken after five days. The germinal tube or promycelium varies considerably in length, and is divided into numerous segments, which are sometimes constricted at the septa, and at first densely vacuolated.

Numerous fusiform, colourless conidia are given off laterally and terminally, in chains of three or more, and each conidium is 3-6 μ long.

The new genus of grass belongs to the group *Agrostideæ*, and there is a smut on *Amphipogon*, from South Australia, named *U. tepperi* Ludw., which somewhat approaches this one, but the aculeate spores are larger, and the sori are in the stems, as well as in the flowers Altogether it is a distinct species, from the mode of germination, the relative size of the spore, and its dense echinulation.

It is named in honour of the Professor of Botany, at Melbourne University, and Government Botanist for Victoria; and this is peculiarly appropriate, since it is the first smut recorded on a native grass belonging to West Australia, and which has been determined by Professor Ewart as a new genus.

EXPLANATION OF PLATE.

Plate I.

Ustilago ewarti McAlp.

Fig. 1.—Smutted panicles of *Sarga stipoidea* Ewart and White, with healthy grain at side; (nat. size).

Fig. 2.—Spores densely covered with spikes; (× 500).

Figs. 3-4.—Spores germinating, and producing more or less slender septate promycelia, with lateral and terminal conidia in chains; (× 500).

THE ENTOZOA OF MONOTREMATA AND AUSTRALIAN MARSUPIALIA. No. ii.*

By T. Harvey Johnston, M.A., D.Sc.

(*From the Bureau of Microbiology, Sydney.*)

(Plate iii.)

A number of additional records have been made since the publication of No. i. of this series (Johnston, 1909, *a*, pp. 514-523); and these, together with a few which had been omitted from that paper, are now collected, the parasites being listed under their respective hosts.

1. Macropus giganteus Zimm.

1. *Filaria* sp., Bennett (1834, p. 293) refers to his finding long, thin, white filariæ encysted in the knee-joint of the kangaroo, *M. major*. There is little doubt but that the parasite is *Filaria websteri* Cobbold.

2. *Coccidium* (*Eimeria*) sp., Johnston, 1910, *a*, p.804. This sporozoon was found in abundance in the intestinal epithelium of a specimen belonging to the above-named species, received by Mr. A. S. Le Souëf, Director of the Sydney Zoological Gardens, from the Coonamble district, N.S.W. Coccidia, apparently all belonging to the same species, have now been found in several wallabies (*infra*).

2. Macropus robustus Gould.

Echinococcus granulosus Gmel., more commonly known as *E. polymorphus* Dies., or *E. veterinorum* Rud. I recorded (1909, *b*, p. 79; 1910, *a*, p. 523) my finding the hydatid in a wallaroo, caught in the western district of New South Wales. This larval parasite is now known to infest at least five species of *Macropus*, viz., *M. giganteus*, *M. robustus*, *M. thetidis*, *M. dorsalis* and *M. ualabatus*.

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* Continued from these Proceedings, 1909, xxxiv., p.523.

3. MACROPUS PARRYI Bennett.

Coccidium (*Eimeria*) sp., was found (Johnston, 1910, *a*, p 433) in the intestinal mucosa of several of these wallabies, sent from South-eastern Queensland to the Sydney Zoological Gardens. The organism appears to be pathogenic to various macropods, and has now been recorded from *M. giganteus*, *M. parryi*, and *M. thetidis*.

4. MACROPUS THETIDIS Less.

1. *Echinococcus granulosus* Gmel. Hydatids were found, *post mortem* (Johnston 1909, *b*, p. 79; 1910, *a*, p. 523) in the lungs of some wallabies of this species which were collected by Mr. H. Burrell, in the New England district, N.S.W., and sent to the Sydney Zoological Gardens.

2. *Coccidium* (*Eimeria*) sp., Johnston, 1910, *a*, p. 523, from the intestinal mucosa (New England, N.S.W.).

5. MACROPUS UALABATUS Less. and Garn.

1. *Echinococcus granulosus* Gmel. Hydatids were recognised (Johnston, 1909, *c*, p. xxix.) in the lungs of a black wallaby, the specimen being collected in the Gosford district, N.S.W., by Mr. L. Gallard.

2. *Bancroftiella tenuis*, Johnston. This cestode was taken from the intestine of this host in Victoria, by Mr. A. S. Le Souëf; a description will be found below.

6. MACROPUS RUFICOLLIS Desm.

Distomum (*Fasciola*) *hepaticum* Abildg. The presence of the liver-fluke of sheep and cattle in the bile-ducts of the red-necked wallaby, is now recorded for the first time. The only other marsupial from which it is specifically recorded is *M. giganteus*, though Cobb (1904, p. 659) mentioned that he had found the parasite in wallabies, but without designating the species of the host. My specimens were collected, for me, by Mr. Herbert Randell, who obtained them in the Yetholme district, near Bathurst, N.S.W.

7. PETROGALE PENICILLATA Gray.

Sarcocystis mucosa (Blanchard), from the subintestinal connective tissue, is mentioned by Minchin (1903, p. 351), but I have not been able to find Blanchard's original account.

8. ONYCHOGALE FRENATA Gould.

Filiaria sp. (Johnston, 1910, *b*, p. xii.). This nematode occurs in small nodules in the subcutaneous tissues of the bridled wallaby, and was collected in Gippsland, Victoria, by Mr. A. S. Le Souëf.

9. DENDROLAGUS BENNETTIANUS.

Filaria sp. (Johnston, 1910, *b*, p. xii.). This parasite was collected by Mr. Le Souëf, from the subcutaneous tissues of Bennett's tree-kangaroo (Northern Queensland).

10. TRICHOSURUS CANINUS Ogilby.

Filaria sp. (Johnston, 1910, *b*, p. xviii.). Mr. L. Gallard found this entozoon in the short-eared opossum, in the Gosford district.

11. PETAURUS SCIUREUS Shaw.

Hæmogregarina petauri Welsh and Barling, 1908. The account was republished in 1909 (p. 329).

12. PHASCOLOMYS URSINUS Shaw.

Moniezia diaphana Zschokke (1907, p. 261). This cestode was taken from the liver of a wombat, *P. wombat* Pér. If the specific name of the host be correct then the locality would be Tasmania, or the neighbouring islands of Bass Strait, as this species is confined to that region. The differences between it and *P. mitchelli* Owen, the form found on the Australian mainland, are very slight.*

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* Lyddeker, Handbook to the Marsupialia and Monotremata, 1894, p. 128 (Allen's Naturalist's Library).

13. PERAMELES NASUTA Géoffr.

1. *Hæmogregarina peramelis* Welsh and Dalyell (1909, p. 112). This hæmatozoon was described from material collected in New South Wales.

2. *Gigantorhynchus* sp., Johnston, 1910, *b*, p. xviii. This specimen was collected near Gosford, N.S.W., by Mr. L. Gallard, and appears to be identical with *G. Semoni* Linst.

3. *Linstowia semoni* Zsch. Linstow (1903, p. 2872) recorded the presence of *Tænia* (?) *semoni* Zsch., in a long-nosed bandicoot which had died in the Zoological Gardens, St. Petersburg.

14. PERAMELES OBESULA Shaw.

Echinonema cinctus Linstow (1898, *a*, p. 469). This nematode was described as the type of a new genus, *Hoplocephalus*, but as the name was already preoccupied, he substituted (1898, *b*, p. 627) a new name, *Echinonema*, for it.

15. DASYURUS VIVERRINUS Shaw.

Hæmogregarina dasyuri Welsh, Dalyell and Burfitt (1908). The description was republished in 1909 (1909, p. 383).

16. PHASCOLOGALE PENICILLATA Shaw.

Gigantorhynchus sp. (Johnston, 1910, *b*, p. xviii). This echinorhynch was taken from the intestine of the "brush-tailed rat." It is possible that the host may be *Bettongia penicillata* Gray (New South Wales).

BANCROFTIELLA TENUIS,

A Cestode from the Black Wallaby, *Macropus ualabatus* Less. & Garn.

I am indebted to Mr. A. S. Le Souëf for mounted preparations of a tapeworm, taken by him from the intestine of the common wallaby, *Macropus ualabatus* Less. & Garn., in Victoria. The specimens are fragmental, a scolex being present on one slide. The exact length of the parasite is not known, but appears to be about seven centimètres, the greatest width (which is at the end) being 1·62 mm.

The scolex is very small, its maximum breadth only reaching 0·210 mm. The anterior end is a truncate cone, the summit of which bears a retractile rostellum, whose full length is about 0·11 mm., and its breadth 0·25 mm., the free extremity being expanded into a low cone of 0·065 mm. broad, bearing a double series of hooks. In Fig.1, the organ is seen to be partly retracted into its muscular sac. There are about sixteen hooks, their length reaching about 0·028 mm. The dorsal root is long and narrow, the ventral root being short, and the claw long, thin, and well curved (Fig.8).

Situated on the broadest part of the scolex are the four suckers, whose diameter is 0·080 mm., the openings being laterally and slightly anteriorly. Behind these organs, the head gradually narrows into the unsegmented neck-region, which extends for a distance of 0·56 mm., behind the suckers. The narrowest portion is only 0·105 mm., and is just at the point of the commencement of segmentation.

The strobila consists of very numerous proglottids, whose size and form vary considerably in different parts of the chain. Just behind the neck, their length is 0·032 mm., and the breadth 0·130 mm., the ratio being 1 : 4. The posterior margins scarcely project in this portion (Fig.1). Further back the form becomes considerably altered, the length being 0·16 mm., the breadth at the anterior end of the segments 0·08, and at the posterior margin 0·13 mm., the ratio now being nearly 4 : 3. The margin of the strobila is here strongly serrate, and the segments scarcely overlap (Fig. 2). More posteriorly the form is again altered, the proglottids now becoming more quadrate and relatively shorter, and the hinder margin less projecting, the ratio of length (0·081 mm.) to breadth (0·178 mm.) being under 1 : 2. The lateral margins are here convex (Fig. 3). Beyond this, the segments become much wider (0·534 mm), and overlap to a very considerable degree, more than one-third of each being overlapped by the proglottis immediately anterior to it. The posterior third of each segment (*i.e.*, the overlapping portion) in this region is very thin. The ratio of length (0·178 mm.) to breadth is 1 : 3 (Fig.4). This is followed by a region in which there is an increase in size, and in the degree of development of the segments, all the genitalia being present, though small and not yet functional. The edge presents a serrated appearance, as the margins project considerably. The amount of overlap is small, amounting to about one-fifth of the length. The ratio of length (0·32 mm.) to breadth (0·84 mm.) is about 2 : 5 (Fig.5). Segments which have reached sexual maturity, have almost the same form (Fig.6), except that they are slightly longer, reaching 0·42 mm., and are much less overlapped by the preceding proglottis. Ripe segments have about the same length as the last-mentioned, but are much broader, being 1·62 mm. in width, the ratio thus being 1 : 4. Similar variations in the entire strobila were seen in fragments of another specimen belonging to the same species.

Having only microscopic preparations available, no sections were made, and consequently details regarding the body-wall, musculature, etc., cannot be given. Throughout the greater part of the cortex of the strobila, there are numerous large, calcareous bodies of an elliptical form, measuring about 0·012 by 0·0075 mm. They are less abundant in the anterior portion of the worm.

The nervous system could not be followed with any certainty. There seem to be three nerves on each side, a main strand and two accessory nerves, the former apparently lying dorsally to the genital canals.

The excretory vessels lie at some distance inwards from the lateral margins of the segments, their course being fairly straight. The ventral pair are large, the lumen of each being about 0·043 mm., the dorsal trunks being very much narrower, their diameter reaching only 0·010 mm. The latter lie just above, and very slightly medianwards from, the ventral vessels. In the region of the genital ducts, the vessels become displaced, the dorsal stem becoming pushed dorsally, and the ventral vessel ventrally, the sex-canals passing between them. At the extreme posterior edge of each segment, the ventral vessels become connected by a narrow transverse vessel. In the scolex and neck-region all four trunks are of the same size. At about the level of the middle of the suckers, the pair of vessels on each side form a loop (Fig.1). No connection between the loops on opposite sides could be detected in the specimen.

Genitalia.—The genital papilla is located laterally, in an irregularly alternating manner, near the anterior margin of each segment. It is usually not very prominent. The genital pore is a rather large circular opening, which leads into a spacious genital cloaca, whose wall contains a relatively large amount of radiating and circular muscular fibres, the latter evidently acting as a sphincter. This common genital chamber may extend inwards for a distance of 0·10 mm., its greatest width reaching 0·05 mm. Its usual form may be seen in Fig.9. At times the whole organ may be much more elongate and distinctly tubular, probably as a result of the action of the muscles in its walls (Fig.10). The length then may reach 0·117 mm. but the lumen becomes very narrow, being only 0·007 mm. Opening into the inner end of the cloaca, one may readily recognise the male and female apertures, the former lying immediately in front of the latter, both being placed at about the same dorso-ventral level. Occasionally the female pore is slightly more dorsally situated. The male opening faces postero-laterally, and the female antero-laterally, the two thus lying very close, and in such a position as would suggest the probability of self-impregnation in each segment, an event which was seen frequently in the mature parts of the chain (Fig.10). Both pores not infrequently lie just between the excretory vessels, though their usual position is just laterally to them.

The testes occupy two fields, an anterior and a posterior, separated by the female glands. The anterior field consists of from fourteen to seventeen vesicles lying between the cirrus-sac, vas deferens, female glands, and the dorsal vessel The posterior field consists of about the same number of glands, these occupying the whole of the dorsal portion of the medulla lying between the female glands and the transverse excretory vessel, and between the longitudinal excretory vessels in the transverse plane. There are thus about thirty-two vesicles altogether. They are rounded or slightly elliptical, having a diameter of from 0·038 to 0·05 mm.; and are disposed in two rows in the dorsal region of the medulla. Lying in the angle formed by the vagina and the cirrus-sac, is the vas deferens, a closely coiled structure. From it there passes, forwards and inwards, an uncoiled portion which enters the cirrus-sac in the extreme anterior part of the proglottis.

The cirrus-sac is a very long tubular organ, lying in the anterior corner of the segment, and extending from near the middle of the anterior margin to the genital cloaca. It frequently exhibits a few loose open coils, thus resembling part of a cork-screw. Its total length is about 0·16 mm., and the breadth 0·034 mm. The musculature is well developed. From its inner end, retractor fibres pass off laterally and slightly ventrally. Within the sac, one may see the coiled male duct ending at the male pore. No distinct external vesicula seminalis was seen. In most of the segments the cirrus was partly everted, and lying in the genital cloaca. The total length of the eversible portion exceeds 0·10 mm. The organ is rather wider at its base than at its extremity. Its surface appears to be devoid of armature. In no case was the cirrus seen projecting much beyond the genital pore, but as the cirrus-sac still possessed its corkscrew-like form, it is quite likely that the fully everted organ may project some little distance through the pore. In one of the segments, self-fertilisation was observed (Fig.10), the cirrus being bent round to enter directly into the vagina, the edge of the male organ reaching a swollen rounded part, which evidently was functional as an outer receptaculum seminis.

As already mentioned, the female pore lies immediately behind, and at about the same dorso-ventral level, as the male aperture. From it there passes inwards, the wide vagina, which almost immediately becomes thrown into a number of irregular coils. In this portion of the duct, one pore is frequently more swollen and rounded than the rest, and, being filled with spermatozoa, evidently acts as an external receptaculum seminis. This latter may be seen persisting even in ripe segments. After passing inwards between the excretory vessels, it commences to arch posteriorly, just behind the coiled portion of the vas deferens, which it crosses dorsally, here widening into an elongate, thin-walled receptaculum seminis. The latter passes into a very short, narrow fertilising duct, which passes through the shell-gland.

The female complex lies just behind the middle of the segment. It has already been stated that it separates the male organ into a posterior and an anterior field. The ovary is a transversely elongate organ, 0·24 mm. in breadth, very distinctly bilobed, each lobe being made up of a number of short tubes. The ovarian bridge lies ventrally below the receptaculum. The short oviduct passes backwards to meet the fertilising canal. The vitellarium lies in the bay between, and behind, the ovarian lobes,as a rather solid organ, 0·075 mm. in breadth, whose margins are lobed. From it, there passes forwards a very short yolk-duct, to the shell-gland, which lies just antero-dorsally to it.

The uterus at first develops in the region of the ovary, but soon begins to increase in size by the development of processes, the other organs in the segment becoming displaced. In the ripest proglottids present in the specimens, the uterus may be seen as a large, ventrally situated, transverse sac with strongly sacculated walls. The whole of the midregion of the segment, with the exception of the extreme anterior portion, becomes filled by it, as it soon comes to extend from the excretory vessels of the one side to those of the other. Some of the processes from the walls penetrate deeply into the cavity, so that the whole organ appears to be made up of a large number of chambers opening into the main, transversely lying portion. In such segments, the male and female ducts still persist, though they are pushed far forwards; the testes, though present, are partly atrophied; whilst, of the female glands, the vitellarium, which lies near the middle of the posterior margin of the proglottid, is the only part recognisable. Ripe eggs were not present, but immature eggs measured 0·011 mm. in diameter, the embryo being 0·006 by 0·004 mm.

Systematic Position.—This parasite of the black wallaby is of considerable interest, as it is the first, armed, adult cestode to be described from a marsupial. All the tapeworms so far known from the Aplacentalia of Australia and the East Indies, belong to the *Anoplocephalinae*, a fact already emphasised by Zschokke (1899). The parasite under review approaches very nearly to the genera *Choanotænia*, *Monopylidium* and *Anomotænia*, but possesses characters which seem to me to be of sufficient importance to justify the erection of a new genus, *Bancroftiella*, for its reception, the generic name being given in honour of Drs. J. and T. L. Bancroft, of Queensland, who were the pioneers of Australian parasitology. The following may serve as a generic diagnosis:—

Dipylidiinæ (of Stiles = Dilepinæ of Fuhrmann); rostellum armed with two rows of hooks; genital pores irregularly alternating; genital ducts passing between the excretory canals; testes numerous, arranged in two fields, an anterior and a posterior, separated by the female complex; uterus saclike with numerous septa projecting into and dividing up the cavity.

Type-species *Bancroftiella tenuis*, n.sp., from *Macropus ualabatus*, the type-specimen being deposited in the Australian Museum, Sydney. This genus differs from the three genera mentioned above, in the disposition of the testes; and from the last two, in the character of the uterus. *Choanotænia* has a single circlet of hooks on the rostellum.

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EXPLANATION OF PLATE III.

Bancroftiella tenuis, n. sp.

Fig. 1.—Anterior end of the strobila.

Figs. 2-7.—Successive portions of the strobila.

Fig. 5.—Segments showing immature genitalia.

Fig. 6.—Segments showing mature genitalia.

Fig. 7.—Segments showing uterus.
(All the above are drawn to the same scale).

Fig. 8.—Hook from scolex.

Fig. 9.—Cloaca showing genital apertures, etc.

Fig. 10.—Cloaca, etc., showing self-impregnation.

Reference letters.

c., cirrus—*c.s.*, cirrus-sac—*c.s.r.*, cirrus-sac retractor—*d.e.v.*, dorsal excretory vessel—*g.c.*, genital cloaca—*g.e.*, genital papilla—*n.*, nerve—*ov.*, ovary—*r.s.*, receptaculum seminis—*t.*, testes—*tr.v.*, transverse excretory vessel—*u.*, uterus—*v.*, vagina—*v.d.*, vas deferens—*v.g.*, vitelline gland—*v.e.v.*, ventral excretory vessel.

NEW SPECIES OF AVIAN CESTODES.

T. Harvey Johnston, M.A., D.Sc.

(*From the Bureau of Microbiology, Sydney, N.S.W.*).

(Plates iv.-vi.)

Choanotænia meliphagidarum, n.sp.

(Plate iv.)

The small intestines of several species of birds belonging to the family *Meliphagidæ* ("honey-eaters") more or less frequently harbour a thin, delicate, multi-segmented and relatively long cestode of about 45 mm. in length. This parasite has so far been found in the following species, in the Sydney and Hawkesbury districts, by Dr. J. B. Cleland and myself—*Meliornis novæ-hollandiæ* Lath., *Meliornis sericea* Gould, *Ptilotis leucotis* Lath., and *Ptilotis chrysotis* Lath.,(Syn. *P. lewini* Swainson).

Scolex:—The scolex is very small, short and rounded in general form. A very slight constriction marks it off from the rest of the body. Its maximum breadth is at about the level of the posterior edge of the suckers, where it measures nearly 0·2 mm., whilst at the neck-constriction the width is 0·166 mm., immediately behind which the strobila again widens to about 0·2 mm. The rostellum is small and unarmed. The entire rostellar sac is a pyriform structure of about 0·097 mm. long, and having a maximum breadth of 0·042 mm. In a few of the specimens examined, the rostellum was seen to be protracted, and appeared to be a fairly prominent conical projection, whilst in others it was quite retracted. In fig.1, it is shown partly withdrawn. The organ in question shows a similarity to that in some unarmed species of *Hymenolepis*, e.g., *H. diminuta* from rats and mice.

The four suckers are rounded and cuplike, having a diameter of 0·058 to 0·068 mm. Their musculature is moderately developed, and the rather considerable depth of the cavity should tend to increase their efficiency. As will be seen from fig.1, they do not project to any degree when viewed dorsoventrally, but in a specimen seen in end-view, the four suckers were seen to occupy the diagonals of the scolex, which here appeared in section to resemble a square with the corners rounded off. When examined laterally, these organs are seen to project prominently.

Strobila :—Segmentation is faintly recognisable at 0·312 mm. from the anterior end, the portion between this point and the head constituting a short unsegmented neck. The transverse septa separating adjacent proglottids are visible just behind this neck, and a short distance further back (0·6 mm. from the anterior end), the divisions may be recognised marginally by the presence of small indentations. In this part of the strobila the segments are about 0·174 mm. broad, by 0·052 mm. long, the ratio of breadth to length being about 3:1. The posterior edges are here well rounded. In front of this the ratio is 4:1. The segments increase gradually in width and considerably in length, the posterior edges becoming obtusely serrate. Well-developed genitalia appear in proglottids with a breadth of 0·71 mm., and a length of 0·45 mm., the ratio here being 8:5. The length continues to increase out of proportion to the breadth. In ripe segments the breadth is about 1 mm., the length 2·4 mm., the ratio now being 1:2·4. The final proglottids are only slightly connected with each other and readily separate The anterior end is broadly rounded, the widest part of the segment now being anterior, just at about the level of the genital pore. Then there is usually a gradual narrowing, followed at the posterior end by slight widening. Some segments showed a considerable thickening at this end, due to the presence of a mass of muscle which is perhaps functional in accelerating their abstriction. Another fact worth noting is that the final segments are very thin, flat and semi-transparent.

Sex openings :—These alternate irregularly, the sequence in a typical part of the chain being L, L, R, R, R, R, L, L, R, R, R, L. The pore may or may not be located on a definite genital eminence. Its situation is marginal and anterior, being at or near the junction of the first and second fourth of the lateral margin. There is frequently a slight depression of the segment-edge, leading into the genital cloaca, which is a relatively deep and narrow passage of 0·025 mm. long by 0·007 mm. broad. The male duct opens just below and in front of the female opening.

Body-wall, Musculature, etc.:—The cuticle when examined in a transverse section of a segment was seen to be rather thin and almost homogeneous, stratification being scarcely recognisable. It stained deeply. Immediately below it there could be distinguished a clearer zone representing the narrow basement-membrane. This was succeeded by the various subcuticular layers, the outermost of which was thin, and, though some structures could be just seen (using $\frac{1}{12}$ immersion lens) in it, their nature could not be made out. Probably, they represented the outer layer of circular muscle fibres mentioned by Blochmann.

The subcuticular cells were very well developed, and possessed the typical spindle-shape. They formed two or three indefinite rows. A deeply staining nucleolus was present. In addition to these cells and just internally to them, there were noticed several branching cells, which appear to represent the myoblasts shown in Blochmann's figures.

Between the subcuticular cells one could see the small bundles of the outer longitudinal muscles. The ring longitudinal muscles were located, as usual, in the cortex, and consisted of two concentric series of bundles near each other. The bundles contained few fibres, and were relatively weak, though those belonging to the series nearest the transverse muscles were much larger than those situated more externally. The transverse fibres enclosed a rather narrow medulla between them, the ovarian bridge bordering on the ventral layer and the upper series of testes on the dorsal layer. They were seen to pass out laterally beyond the nerve through the subcuticula for insertion. The dorso-ventral muscle-strands were moderately developed, but did not show any peculiarities.

Excretory System:—Only one pair of longitudinal excretory vessels is recognisable, these representing the ventral pair. Each has a very wide lumen, being about 0·06 mm. in diameter. These trunks are situated deeply in the parenchyma, at about half-way between the middle and edge of the segment. Sometimes they approximate to one surface (the ventral) of the segment, here bordering on the transverse muscle-fibres, a narrow space being left between it and the dorsal transverse fibres. It is through this space that the genital ducts penetrate, while the uterus comes to pass on the other side.

The excretory trunks lie ventrally to the genital ducts, and arch downwards in passing under them. In mature proglottids, each vessel becomes very considerably widened, and instead of possessing a sinuous course, such as it has in younger parts of the strobila, forms a wide and low arch.

At the posterior end of each segment these main stems are connected by a wide transvere or commissural vessel, with a lumen of about the same diameter as that of the main tubes. On account of the approximation of the latter at the posterior end of the segments, the transverse vessels are rather short. In the riper portions of the strobila the constrictions between the proglottids become so deep, that the ventral trunks approach so closely as to make it difficult to distinguish a distinct commissural vessel.

Nervous System:—The only parts which could be made out were the rather large, longitudinal nerves. Each was seen in section as a strand lying laterally from the excretory vessel of the corresponding side, just at the edge of the medulla. The genital ducts pass dorsally to it.

Male Genitalia:—The testes occupy a compact, rounded zone lying between the main excretory vessel in the transverse plane, and between the female glands and the transverse excretory vessel longitudinally. There are about twenty vesicles, of a rounded or elliptical form, with an average size of from 0·036 to 0·047 mm. They are not all in one plane, but are arranged in two or three rows dorso-ventrally. Though they are generally bounded by the excretory vessels, sometimes vesicles occur laterally from these. In transverse section of a segment, these glands are seen to occupy the middle and upper portions of the medulla. In more mature portions of the strobila, they are surrounded by the reticulated uterus. They appear very early (as will be mentioned later), and persist for a considerable time, being found in proglottids with eggs in a fairly advanced stage of development; but they are here already degenerating, and, by the time the oncospheres have been produced, no trace of the testes can be seen. In many of the segments one may see the individual testes surrounded by a cavity containing young embryos, this reminding one of what happens in many other cestodes, e.g., ***Monopylidium***, ***Dipylidium***, etc. The whole arrangement of the testes and of the female glands is very similar to that met with in these two genera, and in ***Davainea***.

The vas deferens passes forwards along the midline at first as a more or less straight tube, above the testes, vitelline gland, receptaculum seminis, and the ovary. In front of the latter it becomes thrown into a series of folds and coils, and, in a transverse section of this part of the segment, the vas is seen as a rounded mass of coiled tubes occupying the central portion of the section. It extends forwards almost to the anterior end of the proglottid where it rather sharply turns laterally and backwardly in the direction of the genital pore. At about the point where the excretory vessel of the corresponding side passes ventrally to it, the cirrus-sac is entered. The walls of the vas deferens contain longitudinal muscle-fibres.

The cirrus-sac is an elongate tube of approximately equal diameter, extending from about the region of the excretory vessel to the genital pore in a fairly straight course, the length being from 0·12 to 0·13 mm., and the breadth 0·03 mm. Sometimes the sac is rather more spindle-shaped. In all cases the inner end is narrowed to become continuous with the vas deferens. The musculature of the wall is rather weak, the circular and longitudinal fibres being poorly developed.

The cirrus, which lies in a considerably coiled fashion within its sac, may be everted to a relatively considerable length, the longest specimens measured being about 0·13 mm., with a diameter of 0·011 mm. It is thus a filiform structure. This organ does not appear to possess any armature. In cases where it was everted, a very prominent genital eminence was visible. Eversion was only seen in segments in which egg-formation had already begun, but it is probable that no significance is to be attached to this occurrence. A vesicula seminalis was not present.

The female organs consist of the usual glands and their associated ducts, the whole complex occupying the centre of the sexually mature segments, and lying just anteriorly to the testes.

The ovary is situated just in front of the middle of the proglottids lying symmetrically, and may attain a breadth of 0·19 mm., though it is generally rather less than this. It consists of two "wings" connected by a relatively long "bridge," above which pass the male and female ducts. Each wing or lobe is made up of several short, thick, slightly branched tubes. In a transverse section of the segment, the ovary appears as a horseshoe-shaped body with the free ends widened, these being the ovarian lobes. The bridge is ventrally placed, lying adjacent to the ventral set of transverse muscles; while the lobes project upwards, their main mass lying in the middle of the medulla, and their extremities in the dorsal portion of the medulla, at about the same level as the testes. Some of the latter, however, lie still more dorsally, being located adjacent to the dorsal layer of transverse muscles. The ovarian cells are large, rounded and finely granular, with a large, round nucleus containing an eccentrically-placed deeply-staining nucleolus. From the middle of the ovarian bridge there passes off dorsally, the oviduct. This canal forms a small arch dorsally, and then passes ventrally for a very short distance to enter the fertilising duct immediately behind the ovarian bridge.

The vitelline gland is seen to be a compact organ, with a very coarsely granular appearance. It has an irregularly rounded or transversely elongate form, and is situated in the middle just behind the ovary. Its size is about 0·086 mm. broad, by 0·065 mm. long. When examined in transverse section, it is seen to be situated between the ventral limit and the middle of the medulla. It thus stands at about the same level as the ovarian bridge, but, on account of being thicker, its dorsal part lies at the same level as the lower series of testes. The organ is also seen to be made up of relatively large rounded masses of yolk-matter. The duct passes directly dorsally and anteriorly, to enter the fertilising duct at the shell-gland complex.

This latter complex lies, in the form of a rosette, in the mid-line between the vitellarium and the ovarian bridge, its diameter being about 0·04 mm. In section the shell-gland is seen to border on the dorsal transverse muscle-fibres. Thus it lies dorsally to the plane of the ovarian bridge. The component cells are long and clubshaped, the broad rounded portion containing the nucleus embedded in granular protoplasm. A nucleolus is present. The remainder of the cell is long and narrow, serving as a duct. These cells are about 0·018 mm. long. They cover the walls of the fertilising duct for a very short distance. This duct penetrates the complex from its dorsal side.

The vagina opens externally, just behind and slightly below the cirrus-sac. It then travels inwards and slightly backwards as a narrow well-defined tube. Just after it passes over the excretory vessel of the corresponding side, it commences to widen gradually to form an elongate spindle-shaped, thin-walled receptaculum seminis, which narrows again as it approaches the ovarian bridge. Occasionally the receptaculum is more rounded on account of the contained mass of spermatozoa. Soon after passing below the ovary (between it and the vas deferens) the vagina or more correctly the fertilising duct, receives the oviduct; and then, after a very short course, passes downwards to enter the shell-gland complex. It is here that the vitelline duct joins in. Nothing of the nature of a swallowing apparatus was detected.

Situated on the walls of the vagina, in the neighbourhood of the excretory vessel, just where the receptaculum begins, and extending outwardly for about 0·05 mm., is a mass of unicellular glands. Each gland-cell is somewhat flask-shaped, the large, rounded end being nearer the middle of the segment; while the narrow end, which serves as a duct, is directed outwardly. Thus each cell is obliquely placed. The protoplasm is finely granular and homogeneous, the nucleus being large, rounded, not readily staining, and situated in the wider part of the gland-cell. These cells were about 0·009 mm. in length, and were especially evident on that part of the vaginal wall immediately before it passes over into the thin-walled receptaculum seminis.

No bristling of the inner surface of the vaginal wall was recognised.

It may not be out of place to give a brief account of the order of development of the genitalia. The genital rudiments ("anlagen" of many authors) were just recognisable as a small medianly-situated, more deeply staining area, a very short distance behind the region where segmentation became recognisable laterally, that is, at about 0·1 mm. from the anterior end. At 2 mm. distance, the "spot" had lengthened somewhat, and the posterior end of it had become subdivided to form the rudiments of the testes, the anterior part still remaining undifferentiated. Further back, a transversely placed "streak" was seen to arise from the latter portion, and to develop laterally for a short distance. At this time the anterior portion had the appearance of being rather obliquely placed, whilst the testes were now small and numerous, but well defined, and occupied a compact zone in the middle of the hinder third of the segment. At 5 mm. from the scolex, the anterior mass was seen as a dense deeply-staining structure, rather sharply marked off from the testes. The lateral projection had now developed sufficiently to be seen under the excretory vessel, and shortly afterwards became differentiated more or less completely into the two genital ducts, the more anterior being the vas deferens. Lumina could now be detected. The anterior portion of the genital rudiment was now recognisable as the slightly coiled precursor of the much coiled portion of the male duct. This was traceable backwards along the middle of the segment, where it came into relation with the testes. The outer end of the lateral portion now became swollen and somewhat fusiform, this being destined to develop into the cirrus-sac. The ovary and vitelline glands developed later, and more slowly. The male glands had reached their full size, while the female glands were still small. Nevertheless, the latter had practically reached their full development by the time that the vas deferens and vagina had established communication with the exterior. The shell-gland was recognisable fairly early as a glandular mass surrounding the inner end of the vagina (*sensu lato*).

The vas deferens, cirrus-sac, vagina, and receptaculum seminis persisted in segments containing ripe eggs, though all of these ducts were less prominent than in sexually mature segments. The most persistent of the genital organs were the shell-gland and vitelline gland, the former, or rather its débris, being seen in fairly ripe segments. The ovary was recognisable for only a short distance posteriorly from the point where the testes had disappeared.

The uterus originated on the ventral side of the shell-gland complex, and was recognised rather early as a reticulum surrounding the testes. It first occupied the same area as the testes, that is, the middle of the posterior third of the segment. Small eggs were seen lying in the uterine reticulum. As these developed and increased in size, the testes dwindled and finally disappeared. The uterus gradually invaded the rest of the parenchyma, passing forwards and outwards below the excretory vessels. Each lobe or pouch of the uterus contained several eggs, and retained its connection, though sometimes very slightly, with the other parts. The formation of separated egg-capsules lying embedded in the parenchyma, such as is found in the genera *Monopylidium* and *Dipylidium*, was not recognised. The eggs came to be arranged in single layer, spreading laterally from the subcuticular layer of one side to that of the other side, and from the anterior end of the segment to the transverse vessel.

The eggs were rounded or elliptical, the outermost shell measuring 0·05 to 0·07 mm. in diameter, more usually about 0·06 mm. This shell was thin, delicate, and not resistant. The embryo was elliptical, with a diameter of 0·028-0·039 mm, and invested very closely by a delicate shell. This inner shell was in turn surrounded by an irregular loose (albuminous?) envelope. The embryonal hooklets were 0·015 mm. in length, one half being curved and pointed, the other being straight and obtusely rounded.

The ripe segments of this parasite are capable of movement, as I have seen them creeping about in the intestine of a bird which had just been shot. The progression, viewed with the naked eye, appeared to be the result of peristaltic muscular action. Several ripe proglottids showed the presence of a considerable thickening, due to muscular activity at the posterior end. This may be connected with the movement of such segments, or it may serve the purpose of throwing off the succeeding ripe segment while both are connected with the parent strobila.

Systematic Position.—As mentioned above, the four species of birds in which this cestode has been found, all belong to a peculiarly Australian Order, the *Meliphagidæ* or "Honey-eaters." No parasites, excepting Hæmoprotozoa* and *Filariæ*† had been recorded as occurring in members of this family, until I‡ mentioned the presence of these cestodes under the name of *Choanotænia* sp.; though, at the same time, certain differences between this tapeworm and typical members of that genus were noted. A more detailed study of the worm has emphasised the importance of these differences.

The genus *Choanotænia* was founded by Railliet, in 1896, with *Tænia infundibulum* Bloch (syn. *T. infundibuliformis* Goeze) as its type-species. The diagnosis given by Prof. Fuhrmann||, in a recent work, is as follows:—Scolex small, rostellum bearing a single circlet of hooks; strobila consisting of many segments, the last often longer than broad; genital

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* Cleland, J. B., and Johnston, T. H., "Description of New Hæmoprotozoa from Australian Birds," Journ. Proc. Roy. Soc. N. S. Wales, xliii., 1909, pp.75-96; *Id.*, "The Hæmatozoa of Australian Birds," Trans. Roy. Soc. South Australia, xxxiv., 1910, pp.100-114.

Johnston, T. H., "On Australian Avian Entozoa," Journ. Proc. Roy. Soc. N. S. Wales, xliv., 1910, pp.100-112.

† Bancroft, T. L., Proc. Roy. Soc. Queensland, vi., 1889, pp.58-62. Johnston, T. H., *l.c.*, xliv., 1910, pp.110-112.

‡ Johnston, T. H., *l.c.*, xliv., 1910, pp.110-111.

|| Fuhrmann, O., "Die Cestoden der Vogel," Zool. Jahrb. Suppl. Bd., x. Heft 1, 1908, p.54.

pores alternating irregularly; sex-ducts passing between the excretory vessels; testes situated at the posterior end of the segment; uterus sac-like. He goes on to state*, amongst other things, that *Choanotænia infundibulum* had been shown, by Cohn and by Clerc, to possess characters which he regarded as sufficient to justify its inclusion in his genus *Monopylidium*, the type of which is *M. musculosum* Fuhrmann. He, therefore, considered that a new type should be taken for *Choanotænia*, and selected *C. galbulæ* Zeder. Railliet and Henry† then pointed out that, if the type of *Choanotænia* possesses the features of the more recently erected genus *Monopylidium*, then the latter must be a synonym of the former. Moreover, a type-species, when once designated for a genus, cannot be replaced by another in that genus. They then proposed the name *Icterotænia* for the remaining species included by Fuhrmann in his genus *Monopylidium*.

Ransom‡ has recently given a summary of the discussion, but he has retained both *Choanotænia* and *Monopylidium*, though he has given a fuller diagnosis of the former. His reason for maintaining both genera is that, in the former, true egg-capsules do not occur, as far as is known; whilst in the latter genus, they do. He therefore restores *T. infundibulum* to *Choanotænia*, but leaves the other species in *Monopylidium*. As he had studied *C. infundibulum* in detail||, he has been able to give a more extended diagnosis of this genus¶ the following details being either substituted for, or added to, some of those given above:—Genital pores

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* Fuhrmann, O., *l.c.*, p.64, p.66, footnote.

† Railliet, A., and Henry, A., "Les Cestodes des Oiseaux," Rec. Med., Vet. Paris, lxxxvi., 1909, pp.337-8. Quoted by Ransom, B. H., "The Tænioid Cestodes of North American Birds." Bull. 66, U. S. Nat. Mus., 1909, p.74.

‡ Ransom, *l.c.*, p.74.

|| Ransom, Ann. Rep. Bur. Animal Industry, xxi., 1904(1905), pp.277-78.

¶ Ransom, Bull.69, U. S. Nat. Mus., 1909, p.74.

irregularly alternate near the anterior border of the segment; genital canals passing between the longitudinal excretory vessels, and dorsally to the nerve; vas deferens coiled, vesicula seminalis absent; "uterus persistent, sac-like but may be subdivided into numerous, small communicating chambers incompletely separated by partitions infolded from the wall of the uterus, so that in some cases the eggs appear almost as if isolated in the parenchyma."

In *Monopylidium*, there may be a single or a double crown of hooks, the genital pores alternate irregularly, and the ducts either pass* between the longitudinal vessels or dorsally to them. The other features are the same as those in *Choanotaenia*, with the exception of the uterus, which is here strongly branched, and finally breaks down into capsules which usually contain one egg.

We are now able to compare our parasite with these two related genera. The scolex is unarmed in the species under review, but is armed in the representatives of the two genera. The male and female genitalia conform to the same general plan in all three, and the genital pores are similarly arranged. Besides this, the genital ducts pass dorsally to the nerve and the ventral excretory vessel. In *Choanotaenia* they pass between the dorsal and ventral vessels; in *Monopylidium* they pass either between them or dorsally to both; whilst in our species there is only one vessel—the ventral—present, and, as already mentioned, they pass dorsally to it. The uterus in this cestode arises as a reticulum surrounding the testes, very similar to that seen in *Monopylidium passerinum* Fuhrm.† Ripe segments become filled with eggs, so that, at first sight, one might be led to regard the uterus as being sac-like; but in section, it was seen to be made up of a large number of chambers, which maintained their communication with each other. The formation of separated egg-capsules was not recognised. The uterus thus arises as it does in *Monopylidium*, but reaches a condition similar to that seen in the typical species of *Choanotænia*.

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* Ransom, 1909, *l.c.*, p.76.

† Fuhrmann, O., Centr. f. Bakt., Orig., 1, xlv., 1908, p.528. Johnston, T. H., Journ. Proc. Roy. Soc. N. S. Wales, xliii., 1909, p.405.

The type-slide of *Choanotænia meliphagidarum*, taken from *Ptilotis leucotis* Lath., has been deposited in the Australian Museum, Sydney.

ANOMOTÆNIA RHINOCHETI, n.sp.,

from the Kagu,

Rhinochetus jubatus Verr. & Des Murs.

(Plate v.)

Mr. H. E. Finckh, of Mosman, Sydney, was kind enough to hand over to me, for examination, a specimen of this rare New Caledonian bird, which had died after having been in captivity at his home for six months. As this bird belongs to a very aberrant group, and is fast approaching extinction, its intestinal fauna is worthy of some attention. In it, I found numerous very small tapeworms, and abundance of tiny, thin, free segments. The maximum length of the specimens in my possession is 3·7 mm., but, as the final segments readily fall away, and as the parasites were already dead when I obtained them, the length of the strobila may have been a little greater. The terminal segments, however, contained fully developed oncospheres. The chain consists of a relatively powerful scolex, and a comparatively small number of segments.

The Scolex.—Situated at the anterior end of the cestode, is the rounded scolex, which is only slightly wider than the succeeding, short, unsegmented neck. The maximum width is about 0·27 mm. The four suckers are large, and well provided with musculature, the breadth being 0·014 mm. The openings are directed laterally, and slightly anteriorly. On the apex of the scolex is situated a rather long, retractile rostellum, a cylindrical organ of 0·065 mm., in width, excepting at the free end, where it becomes swollen to form a knob

0·086 mm. broad. This knob bears the double row of hooks. The rostellum may be everted to a distance of 0·12 mm. in front of the scolex, or it may be completely retracted into the strongly muscular rostellar sac, which has a length of about 0·22 mm. The hooks are arranged in two rows, each consisting of about ten. In most of the specimens these structures have fallen off, but in the few cases in which they remain in position, one can readily distinguish the presence of two series. The hooks of both circlets are large, being 0·062 mm. long, and possess the form shown in Fig.4. The anterior attachment is long and thin, the ventral root prominent and distinctly bifid, and the claw long and pointed. A few hooks were seen measuring only 0·050 mm. in length, with a much more prominent ventral root than that figured.

The Strobila.—The scolex is followed by a short, unsegmented region having a width of 0·21 mm., and a length of 0·07 mm. The segments nearest the neck are very narrow, but are well differentiated laterally, the margins being acutely serrate. There is an increase in width and length as the segments pass backwards, the posterior angles becoming more projecting; the ratio of length to breadth of the segment is about 7 : 1 in the anterior part of the chain, whereas in segments with mature genitalia it is only 3 : 1, the breadth at the posterior end of these segments being about 0·50 mm., and the length 0·174 mm. In ripe (*i.e.*, egg-bearing) proglottids these dimensions are 0·46 and 0·165 mm. respectively, the ratio thus being nearly the same as in mature portions of the chain. In egg-bearing segments the form is somewhat different, the posterior border being relatively shorter, and the edges much less pronounced. The corners are more rounded-off, and there is less projection beyond the anterior edge of the succeeding joint. There is very little overlapping in this portion of the strobila, and the parts are readily detached. The genital pores, which alternate fairly regularly, are situated on a prominent papilla at about the middle of the edge of each segment. The male opening lies just in front of the female pore. The genital atrium is insignificant.

The musculature is weak. The fibres belonging to the longitudinal muscles are arranged in two concentric series of bundles. Owing to the smallness and fragility of the parasite, I was unable to make satisfactory sections, and consequently cannot give much information relating to the subcuticular structures, the musculature, and the nervous system. The transverse fibres were recognised, lying ventrally just below the developing uterus, and dorsally above the male glands and ducts. The longitudinal nerve was seen to lie laterally beside the main longitudinal excretory vessel. The latter is a well defined tube, with a lumen of 0·006 mm., lying laterally near the junction of the medulla and cortex. Each forms an arch with the concavity inwards, approximately limiting the outer edges of the medulla. A narrow, transverse vessel lying close to the posterior border of each proglottid, connects the main or ventral vessels of each side. A dorsal, longitudinal stem was not seen. The genital ducts pass dorsally to the nerve and excretory trunk of the corresponding side.

Male Genitalia.—The testes are from 17 to 22 in number, and may be recognised, at about 0·4 mm. from the front of the scolex, as a number of small, round, deeply staining bodies arranged in a definite line at the posterior edge of the segment, and extending from the ventral vessel of one side to that of the other side. They rapidly increase in size, and then are seen to be arranged, in surface-view, in two or three overlapping rows, which are at different dorsoventral levels. They lie behind the female glands, though they may somewhat overlap the vitellarium. Their position is distinctly dorsal, the uppermost series bordering on the dorsal transverse muscle. Each vesicle is approximately spherical, having a diameter of from 0·0028 to 0·035 mm. From each of these passes off a large prominent vas efferens, which joins its fellows to form the large, dorsally placed vas deferens. This passes forwards, and then laterally towards the pore-bearing edge. It very soon becomes thrown into an extensive system of coils, occupying a very large part of the mature segment, and lying in the antero-lateral corner of the medulla. Some of the coils may be seen in the middle of the anterior part of the proglottid. In a section of this portion, the vas is seen to fill fully one-quarter of the medulla, and to extend from the dorsal almost to the ventral transverse muscle-layer. At about the mid dorsoventral level of the convoluted mass, the vas passes laterally above the excretory vessel and nerve, to terminate in the weak cirrus-sac. This portion of the vas deferens lies in front of, and approximately parallel to, the vagina. Contrary to the condition usually met with in Cestoda, the testes persist, and may be distinctly recognised in segments containing hexacanth embryos, though they do not appear to be any longer glandular. The vasa efferentia and the vas deferens also remain, the latter being very considerable in dimensions. In fact, the persisting male structures occupy about one-half of the medulla in ripe proglottids.

The cirrus-sac is a long, thin, cylindrical or fusiform structure about 0·07 mm. in length, and 0·016 mm. in width. Its musculature is poorly developed. The cirrus, when everted, is seen to be about 0·004 mm. long, and 0·006 mm. wide; and to be densely covered with minute spines.

Female Genitalia.—The female complex is not situated in the middle of the segment, but lies rather nearer to the pore-bearing edge. The ovary, which is about 0·16 mm. in breadth, is approximately transverse in position, lying immediately posteriorly to the coiled mass of the vas deferens, and in front of the testes and vitellarium. It is a bilobed organ, each lobe or wing consisting of comparatively few ovarian tubes. The lobe which lies near the pore side is situated more ventrally than the other. The bridge connecting the lobes lies more ventrally than these, but anteriorly and slightly dorsally to the shell-gland. A narrow oviduct passes backwards from the "bridge" in a small arch, towards the shell-gland. The vitellarium lies just behind the middle of the ovary, and, like it, lies asymmetrically, being displaced towards that margin which bears the genital cloaca. The organ is about 0·062 mm. broad, by 0·02 mm. long. In general shape it somewhat resembles a lobulated kidney, the hilum being directed antero-laterally. The posterior border is divided to form a few lobes. Its duct passes forwards towards the shell-gland, a small organ lying between it and the ovarian bridge The vitelline gland is the most ventrally placed of the female organs, the ovary being the most dorsal. The shell-gland lies antero-dorsal to the yolk-gland The vagina passes inwards from the female pore posteriorly to the cirrus-sac and vas deferens, dorsally to the ovarian lobe of the corresponding side, to take up the oviduct just behind the bridge near the shell-gland. A receptaculum seminis was not observed. The mature uterus is a flat, sac-like organ which fills almost the whole ventral portion of the medulla. It lies below the vas deferens and the remnants of the testes, these structures being present in ripe segments, and occupying a large part of the dorsal region of the medulla The eggs are circular, the outer delicate shell being 0·035 mm. in diameter, the inner more resistant covering 0·027 mm., and the oncosphere about 0·020 mm. The embryonal hooklets are very delicate, and measure 0·310 mm. in length.

Systematic.—This parasite has been recorded by me * as *Amœbotænia* sp., mention being made of the presence of well developed suckers, an armed rostellum, and somewhat irregularly alternating genitalia. A more careful examination shows that there are two circlets of hooks in this species, whereas members of the genus *Amœbotænia* have only a single row. It seems to come near *Anomotænia* Cohn, and *Laterotænia* Fuhrm., but differs from the latter in the disposition of the testes. I am, consequently, placing it under Cohn's genus.

The type-slide of *Anomotænia rhinocheti* will be deposited in the Australian Museum, Sydney.

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* Johnston, T. H., Journ. Proc. Roy. Soc. N. S. Wales, xliv., 1910, p. 122.

DAVAINEA HIMANTOPODIS, n.sp.

from *Himantopus leucocephalus* Gould.

(Plate vi.)

My colleague at the Bureau, Dr. Cleland, recently collected some entozoa from a White-headed Stilt, *Himantopus leucocephalus* Gould, shot at Tailem Bend, Murray River, South Australia. Amongst them, were a few very small cestodes, measuring a little over 1 mm. in length. Amongst the intestinal contents of the bird, I found several ripe, free segments belonging to the same species.

The Scolex.—The scolex is rounded in general shape, and is marked off from the rest of the strobila by a constriction, almost immediately behind which segmentation begins. The dimensions are: length (excluding rostellum) 0·115 mm.; breadth 0·146 mm., the broadest part being behind the suckers. Situated in the anterior portion, are the suckers, which are only moderately developed, having a diameter of about 0·03 mm. The openings are directed anteriorly or antero-laterally. Around the margin of each there is arranged a row of small hooks, 0·005 mm. long, which are readily lost in dead specimens. Their form could not be clearly distinguished. On the apex of the scolex there is a cuplike depression in which there lies a protractile rostellum. The rostellum is 0·034 mm. long, and has a broader, rounded, free extremity carrying the hooks, connected with the scolex by a narrower, short, stalk-like portion. The maximum breadth of the rostellum is 0·03 mm. Surrounding it there is a double row of small hooks about 0·007 mm. in length (*i.e.*, from the ventral to the dorsal root), and possessing the hammer-form typical in the genus *Davainea*. The claw is relatively powerful. There are about 25 hooks in each row (Fig.3).

Strobila.—As previously mentioned, segmentation follows almost immediately behind the head, consequently an unsegmented neck is practically absent. Most of the tapes examined possessed seven or eight segments. Their general form is shown in Fig. 1. The first proglottid is about 0·017 mm. long, and 0·18 mm. broad, the ratio being 1 : 10. As the length increases much more rapidly than the breadth, this ratio decreases. In the fourth, the length is 0·08 and the breadth 0·273 mm., the ratio being 1 : 3·4. In the sixth segment, where a marked increase in length, accompanied by full sexual maturity occurs, the length is 0·130 and the breadth 0·283 mm., the ratio being nearly 1 : 2. In the seventh segment the difference is about equalised, the segment being rounded, the length reaching 0·243 and the breadth 0·291 mm., the ratio now being 5 : 6. The next segment is frequently much broader, and slightly shorter, being 0·40 by 0·227 mm. It is at this part of the strobila, where egg-formation is actively proceeding, and where the segments themselves seem to be thrown off, as each end of this and succeeding segments (if any) is strongly contracted. Some free proglottids were measured with the following results:—(a) Length 0·390, breadth 0·468 mm.; (b) length 0·437, breadth 0·65 mm. This seems to indicate, either that there is a very considerable increase in growth after the separation of the ripening segments, or (more probably) that those which are ripe are so feebly connected with the rest of the strobila, that they readily become detached.

It will be noticed that, in no case, do the posterior edges of the segments project, but that the lateral margins are convex outwardly.

The genital pores alternate regularly, as a rule, very few exceptions being detected. It is only in the larger proglottids that the pores are present. They are located in the anterior third of the lateral margin. There is no genital papilla, even in cases where the cirrus is everted. The genital cloaca is relatively deep and narrow.

Calcareous corpuscles were not detected, nor was any part of the nervous or excretory system. The longitudinal musculature is seen to be well developed, and to consist of a number of powerful bundles which may be traced from one end of the parasite to the other. They lie rather deeply in the parenchyma. Transverse fibres are well developed at each end of the ripening segments, and probably are functional in bringing about their separation.

Genitalia.—Traces of the male genitalia are to be recognised in the first segment, the rudiments becoming much more distinct in the second, and fairly well developed in the third. In the fifth, sixth, and seventh, both male and female glands are present, the latter very rapidly increasing in size, in passing back from the fifth to the seventh, where they are fully mature. In the sixth and seventh the cirrus-sac and vas deferens are at their maximum development, though male sexual maturity may be reached in the fifth segment. In the latter, the receptaculum seminis may be somewhat distended by the contained spermatozoa. In the succeeding two proglottids, this structure was greatly swollen. In the next, the male and female organs, excepting the cirrus-sac, the vas deferens, and part of the vagina, have disappeared; and, in segments containing ripe eggs, the cirrus-sac is the only other structure recognisable. In some instances there were indications that self-fertilisation takes place, as the end of the cirrus appeared to be bent round to enter the lateral part of the vagina.

Male genitalia.—There are four testes, of a rounded or elliptical form, being from 0·043 to 0·060 mm. in diameter. Three are situated behind the ovary, the other being lateral to it on the side remote from the genital pore. The vas deferens is a wide, coiled tube lying just behind and internally from the cirrus-sac. It ultimately enters the inner end of the sac as a narrow tube, the greater part of it being thin-walled, and thrown into a few long loops. It then passes back again to enter the cirrus, which, in the state of rest, is about 0·11 mm. long.

The cirrus-sac is a large, elongate, fusiform organ situated in the antero-lateral corner of the segment. Its walls are moderately muscular. From the inner end there pass off retractor muscle-fibres. The whole sac is situated well within the segment, there being a narrow, canal-like, genital cloaca (0·046 mm. long) leading from the male and female openings to the exterior. The male aperture lies just in front of the female. When the sac is contracted, and the cirrus therefore everted, the former appears as a small, pyriform body with rather thick, muscular walls. The everted cirrus, which is about 0·098 mm. long and 0·015 mm. broad, projects through the common genital pore for a distance of 0·062 mm. It possesses a very characteristic armature, represented in Fig.5: at, and near the free end, there is a large number of long, delicate, stiff, hyaline spines (0·031 mm. to 0·047 mm. in length), which gradually taper. These come to project backwardly. In the figure, many are seen with their points directed forwards, the cirrus evidently not being fully everted. Just behind these, the tube is covered externally by a great number of very small thornlike spines, but just at the base of the eversible portion, these become replaced by a third kind. These last are much fewer in number, and larger in size, and project more prominently than the last-mentioned. They have a much wider base.

Female genitalia.—The female complex is situated at about the middle of the segment, though it is generally slightly displaced towards the pore-bearing margin. The ovary, when mature, is a large bilobed organ, the wings being connected by a short ovarian bridge which is not readily recognisable. Each lobe is a rounded mass, not differentiated into egg-tubes. The diameter of each is about 0·07 mm., the total breadth of the organ being nearly 0·14 mm. A short oviduct passes backwards from the middle of the ovary. The position of the gland in relation to the testes has already been mentioned. It lies antero-dorsally to the vitellarium, which is the most ventrally placed of all the reproductive glands. The latter is a compact round organ of 0·046 mm. diameter, situated near the midline, just behind and between the ovarian wings. From it the vitello-duct passes forwards. A shell-gland was not observed, nor was the point of junction of the vagina and the other female ducts made out.

The vagina is a wide, short tube leading from the female pore inwards, to become greatly widened to form a rounded receptaculum seminis lying between the ovarian lobe of that side and the cirrus-sac. A short continuation of the canal passes inwards and backwards below the middle of the ovary. Its course could not be followed further.

The uterus does not persist, as the eggs in segments which have just passed sexual maturity, are found in great numbers in the parenchyma. The eggs are rounded, having a diameter of 0·0234 mm., the shells closely investing the oncospheres. The embryonal hooklets are very delicate, and are only 0·008 mm. in length.

Systematic.—The only other species of *Davainea* described from birds belonging to the *Charadriiformes*, is *D. minuta* Cohn* from *Tringa totanus* (from North Germany), a host-name which Fuhrmann † has not been able to find. *D. himantopodis* and *D. minuta* show very close resemblance in regard to the form of the strobila, the characters of the scolex, and the general disposition of the genitalia as given in Cohn's figure. A comparison of the two accounts shows that the former differs from the latter in the following points · the smaller scolex, the possession of fewer testes, and the much earlier appearance of both male and female genital organs. Cohn's account is short and incomplete, as he had only immature specimens.

The type-slide of *D. himantopodis* will be presented to the Trustees of the Australian Museum, Sydney.

EXPLANATION OF PLATES iv.-vi.

Plate iv.

Choanotænia meliphagidarum.

Fig. 1.—Scolex.
Fig. 2.—Segment showing genitalia.
Fig. 3.—Female organs, etc.
Fig. 4.—Egg.

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* Cohn, L., Nova Acta, etc., lxxxix., 1901, p.414.

† Fuhrmann, Zoolog. Jahrb. Suppl. Bd.x.,1,1908, p.119.

Plate v.

Anomotænia rhinocheti.

Fig. 1.—Anterior part of strobila, rostellum everted.
Fig. 2.—Anterior part of strobila, rostellum retracted.
Fig. 3.—Segments, showing anatomy.
Fig. 4.—Hook from rostellum.

Plate vi.

Davainea himantopodis.

Fig. 1.—Entire strobila, with some free segments in addition.
Fig. 2.—Scolex.
Fig. 3.—Hook from rostellum.
Fig. 4.—Mature segment showing genitalia.
Fig. 5.—Portion of segment, showing everted cirrus bearing the characteristic spines.

Reference letters.

c., cirrus—*c.h.*, cirrus-hooks—*c.s.*, cirrus-sac—*e.*, eggs—*g.e.*, genital eminence—*r.h.*, rostellar hook—*n.*, longitudinal nerve—*o.d.*, oviduct—*ov.*, ovary—*r.s.*, receptaculum seminis—*s.g.*, shell-gland—*t.*, testes—*tr. v.*, transverse excretory vessel—*v.* vagina—*v.c.*, gland-cells on vaginal wall—*v.d.*, vas deferens—*v.g.*, vitelline gland—*v.e.v.*, ventral excretory vessel—*y.d.*, yolk-duct.

ORDINARY MONTHLY MEETING.

April 26th, 1911.

Mr. W. W. Froggatt, F.L.S., President, in the Chair.

Mrs. **Isabel A. Salusbury**, Sydney; Messrs. **Tom Iredale**, London; **William Rowan Browne**, University of Sydney; **Ernest Arthur D'Ombrain**, M.B., Sydney; **William F. N. Greenwood**, Hawkesbury Agricultural College; **Ewen Mackinnon**, B.Sc., Department of Agriculture, Sydney; and Professor **Robert Dickie Watt**, M.A., B.Sc., University of Sydney, were elected Ordinary Members of the Society.

The President announced that, under the provisions of Rule xxv., the Council had elected Mr. T. Steel, F.L.S., Mr A. H. Lucas, M.A., B.Sc., Mr. J. R. Garland, M.A., and Mr. C. Hedley, F.L.S., to be Vice-Presidents; and Mr. J. H. Campbell, [Royal Mint, Macquarie Street] to be Hon. Treasurer, for the current Session.

The President also gave notice that, during the winter months (May-August), the Monthly Meetings would begin at 7.30 p.m., instead of 8 o'clock.

The Donations and Exchanges received since the previous Monthly Meeting (29th March, 1911), amounting to 16 Vols., 73 Parts or Nos., 10 Bulletins, 5 Reports, and 6 Pamphlets, received from 48 Societies &c., were laid upon the table.

NOTES AND EXHIBITS.

Mr. Basset Hull exhibited an egg and nestlings of *Oestrelata leucoptera* Gould (White-winged Petrel), taken at Cabbage Tree Island, near the entrance to Port Stephens, N.S.W. The egg was taken on the 4th December, 1910, on which date many birds were found sitting on fresh or slightly incubated eggs. The nests were placed amongst loose boulders or in crevices under rocks in a gully densely wooded with the Cabbage Palms (*Livistona australis*) to which the Island owes its name. Very little material was used to line the hollows in which the eggs were laid, merely a few shreds of fibre or dead fronds forming the nests. The eggs are pure white, without gloss, stout, rounded, oval in shape, average dimensions 1·96 × 1·46 inches. The nestlings were taken on 30th January, 1910; they were in down, bluish-grey on the upper surface, and greyish-white on the breast. The feet show the characteristic colouration of the adult bird, the basal half of the interdigital membrane being black.

Mr. A. R. McCulloch exhibited, by permission of the Curator of the Australian Museum, specimens of *Gadopsis marmoratus* Richardson, from Manilla on the Namoi River, and Rylestone on a tributary of the Macquarie. This species does not appear to have been previously recorded so far north. Also a specimen of *Epinephelus lanceolatus*, Bloch, from Clifton, N.S. Wales. A specimen of this fish was exhibited by Sir William Macleay, in 1886, which was obtained in the Cairns district, Queensland, and is apparently the only other Australian specimen known. A drawing of *Schuettea scalaripinnis* Steindachner, was exhibited. This species was described from Port Jackson, in 1866, but has been overlooked by all later writers. An allied species was described from West Australia by Mr. Waite, in 1905, as *Bramichthys woodwardi*; while Steindachner's species was again noted from Sydney, though under Waite's name, in the following year by Mr. Stead. A comparison of specimens, however, shows that the eastern and western forms are distinct, so that the former should be known as *S. scalaripinnis*, and the latter as *S. woodwardi*.

Dr. T. H. Johnston exhibited specimens of barnyard-grass (*Panicum crus-galli*), showing the presence of a smut, *Cintractia crus galli* Tr. and Earle (collected by Mr. W. M. Carne at Richmond, N.S.W.); and of *Dampiera stricta* R.Br., infected with the æcidial stage of a rust, *Puccinia dampieræ* Syd. (collected by Dr. Cleland at Middle Harbour, April, 1911).

Mr. A. A. Hamilton showed specimens of six species of plants collected at Douglas Park, on December 31st, 1910, which had not previously been recorded from that locality—*Didymotheca thesiodes* Hook. (new for N S.W.); *Anthocercis albicans* Cunn. (Fl. Austr.: Bathurst, Cassilis ; *Solanum campanulatum* R. Br. (Fl. Austr.: Port Jackson to Queensland); *Zornia diphylla* Pers. (Fl. Austr.: Port Jackson to Queensland); *Heleocharis cylindrostachys* Boeck. (Fl. Austr.: Camden to Queensland); and *Schœnus Moorei* Benth (Fl Austr.: Port Jackson district).

Dr Chapman pointed out that at certain seasons of the year it was not uncommon to find samples of milk which contained less than 8·5 per cent. solids not fat. It was also known that the milk from certain cows and from certain races of cows yielded less than 8·5 per cent. solids not fat. It was therefore erroneous to conclude that a milk containing less than 8·5 per cent. solids not fat had necessarily been adulterated with water. In the case of certain Durham cows, it was noted that although the amount of solids not fat was less than 8·5 per cent, the amount of fat was high, viz, 4·6 per cent. Such milks have a high caloric value, and are therefore valuable as foods.

Mr. Fred Turner exhibited, and offered observations on :—(1) *Cuscuta tasmanica* Engelm., found on *Medicago sativa* Linn., in the Bombala distict, N.S.W., and regarded as a great pest. Mr. Turner was the first to record this interesting parasitical plant for New South Wales ("Agricultural Gazette," Vol. ii., p. 289, 1891), a specimen having been forwarded to him for identification by the Rev. W. F. Frazer, Murrurundi, who found it on the introduced *Marrubium vulgare* Linn.—(2) *Kochia scoparia* Schr., found near Glen Innes, New England, N.S.W., where it has recently appeared in the pastures. This annual Chenopodiaceous plant, indigenous to Greece, is cultivated in European gardens for its decidedly ornamental appearance. In summer the foliage is light green, and in autumn it assumes a crimson colour. —(3) Abnormal inflorescence of *Sechium edule* Swartz, var. *viridis*, a West Indian Cucurbitaceous plant. On several of the ovaries, each containing a single pendulous ovule, the flowers were didymous, some quite free and others confluent, but all the stigmas were perfect, and the fruit normal The exhibitor had grown the plant in his garden for many years, but never before had he observed the flowers in the condition shown

Mr. North sent for exhibition a skin of *Puffinus carneipes* Gould, from Lord Howe Island, and of *P. chlororhynchos* Lesson, from South Solitary Island, on the northern coast of New South Wales, together with the following note—"The skin of *P. carneipes* is from one of three live birds presented on the 27th March, 1911, to the Trustees of the Australian Museum, by Mr. William Whiting of Lord Howe Island. Much confusion has existed in connection with this species. Dr. E. P. Ramsay referred the birds collected by Mr. Etheridge and party of the Australian Museum, in August-September, 1887, on Lord Howe Island, to *Puffinus brevicaudus* Brandt (= *P. tenuirostris* Tem); likewise the eggs and birds, collected by Mr. E. H. Saunders, in the same locality in November of the same year. On the 28th January, 1904, I added *P. carneipes* to the Lord Howe Island avifauna, in the "Records of the Australian Museum," Vol. v., p. 126, and found out on visiting that locality in October, 1910, that *P. carneipes* was the common species breeding in the dense palm and banyan vegetation between Middle Beach and Transit Hill. *P. tenuirostris* does not occur on Lord Howe Island, or in its vicinity. The other specimen, *P. chlorohrynchos*, was one of several received by the Trustees of the Australian Museum from Mr. Jennings, of South Solitary Island, on the 18th November, 1878. In the Society's Proceedings (Vol. iii., p. 406, 1879), Dr. Ramsay erroneously attributed these birds, together with their eggs, which he described, to *P. carneipes*.

Mr. North also contributed the following note on a further description of the genus *Ashbyia*. "In the March, 1911, number of the "Agricultural Gazette of New South Wales," I briefly characterised the genus *Ashbyia*, which may now be amplified. Bill about half as long as head, nearly straight, comparatively deep, but broader than deep at nostril, the upper mandible arched and gently decurving towards the tip; wings nearly twice the length of tail, the first primary very short, the third longest, the second and fourth nearly equal; the longest upper tail-coverts half the length of tail-feathers; tarsus comparatively slender, about half the length of tail-feathers; middle toe the longest, and, without the claw, equal in length to the hind toe with claw. The genus *Ashbyia* is allied to *Ephthianura*, but the latter may be distinguished by its more slender and pointed bill, its shorter wing and different wing-formula, and by its longer upper tail-coverts."

STUDIES IN THE LIFE-HISTORIES OF AUSTRALIAN ODONATA.

No. 4. FURTHER NOTES ON THE LIFE-HISTORY OF PETALURA GIGANTEA Leach.

By R. J. TILLYARD, M.A., F.E.S.

(Plate vii.)

Since the publication, in 1909*, of my paper on the life-history of *Petalura gigantea* Leach, I have collected a considerable amount of new and interesting information about it. This is now included in the present paper, and brings the study of this remarkable species much closer to completion.

After I had obtained the supply of exuviæ from the Leura swamp (Blue Mountains), in 1908, I determined, if possible, to find the living larva. For this purpose, I visited Leura in October, 1909, and searched the swamp carefully, collecting mud from various "pot-holes" and examining it, and also dredging the larger holes in the swamp. No success attended these efforts. However, during a visit to Medlow, Blue Mountains, in the middle of November, 1909, I found a fairly large and conveniently situated swamp, over a restricted portion of which the *Petalura* exuviæ were found clinging to the reed-stems. The next morning I got up about 5.30 a.m., and visited this swamp. As I expected, the *Petalura* larvæ were emerging in fair numbers, and many were only just climbing out of the swamp. As I particularly wanted to examine the gizzard of the larva, I collected half-a-dozen quickly into a box, and returned with them. But so rapidly was the final change approaching, that, by the time I got back, they were all emerging in the box. In any case, the actual internal metamorphoses had proceeded too far for an examination of larval structures, even if I had attempted it the moment I took them.

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* Studies in the Life-Histories of Australian Odonata, Part i., These Proceedings, 1909, Vol., xxxiv , p.697.

Returning to the swamp, I set about trying to solve the problem, where and how the larvæ lived. My friend, Dr. F. Ris, to whom I had sent specimens of the exuviæ, had pointed out to me that, in every case, the anal opening was wide open in the cast-skin. This fact led him to believe that these larvæ were not aquatic, but air-breathers. Bearing this in mind, I selected a large clump of sedge in the middle of the swamp, to which three exuviæ were clinging, and carefully examined the clump itself. Close to the base of the stalk on which the first exuviæ were found, I discovered a neat round hole, about half-an-inch in diameter. On examining the bases of the other two stalks which carried exuviæ, I found similar holes. Passing on to other clumps, I found that, in every case where there were exuviæ on the reed-stems, a neat, round hole occurred close by, near the base. Next, with a knife, I cut away the edge of one of the holes, and followed it down. It was very damp, and the sides smooth and plastered with the soft mud of the swamp, enclosing the matted roots of the sedge. At the water-level the hole was, of course, full of water, and thence downwards it got looser, finally becoming indistinguishable in the watery ooze lower down.

It was now necessary to decide whether these holes were made by the larvæ simply for the purpose of emerging, or whether they were more or less permanent, and used as channels of communication, or perhaps for foraging excursions, possibly at night-time. As the larvæ had nearly all emerged, I had to wait another year before I could carry on this investigation. On November 5th, 1910 (a date chosen as likely to give a prospect of finding the larvæ nearly full-fed, but not yet emerged), Mr. C. Gibbons, of Hornsby, and myself went to the swamp at Medlow. We were provided with a long-bladed draining-spade, and two large, sharp knives for cutting the sedge. The swamp was unaltered in appearance, and I soon found a large clump (marked A in the diagram) near the spot which I had examined a year previously. On cutting away the sedge level with the clump, we found three distinct, round holes. These were the entrances to three nearly vertical channels, of which two (a_1 and a_2) are shown in the diagram. By slicing away the matted roots surrounding them, we cut down to the water-level, about six inches, and then followed the channels down another foot or more, where they turned into a wider and looser horizontal channel. The latter, however, was soon lost, as it collapsed on examination. The outer channel, a_2, being in firmer mud, proceeded downwards another six inches or more, and then turned into a horizontal channel, loose, and easily destroyed like the other.

We next began to dig out the clump A at the side bordering the small depression or water-hole C. On cutting out a slab, the whole depth of the hole, we discovered a well-made channel (a_3) opening out at the side of the clump A, *below* the water-level. This was not quite vertical, and on following it down, about a foot, it turned into a softer, horizontal channel, which I took to be the same one that connected a_1 and a_2. I then followed this horizontal channel under C, where the mud was very loose and slimy. As long as there were roots enough to hold together at all, there was a distinct passage; but it collapsed almost on touching. However, it seemed to be a distinct connection, of a very flimsy kind, leading from the clump A, under C, to the clump B, and was about the right width for the easy passage of *Petalura* larvæ. Probably, in the softer ooze, the larvæ just push their way along, and leave an unstable passage-way behind them, which collapses whenever a rain-storm increases the pressure from above.

So far (after working nearly an hour) we had found no larvæ. But on dredging out the soft mud along the horizontal channel under C, we found two in quick succession, both males and fairly well-grown. I was surprised to find them so different in appearance from what I had imagined when I examined the exuviæ. They are very flabby, and appear ill-nourished. In colour, and to the touch, they are rather like the fleshy white grubs of Scarabeid beetles so commonly found when gardening. The abdomen is fleshy-white all over, except along the lateral edges of the segments and round the anal extremity, where the dark stain of the ooze seemed to have become more or less permanent. The thorax is also fleshy-white, but not quite so flabby, with a distinct orange band passing on each side from the wing-base to the mesocoxa. The head is whitish behind, but much darker on the vertex and front, and especially on the labrum, which is a hard plate, nearly black. The eyes are quite black in front. The labium is pale glaucous-greyish, with the lateral lobes and hook brownish. Wing-cases pale greyish. Femora whitish, darker on the inner side; tibiæ and tarsi fairly hard and dark. From the fact that only the front of the head and parts of the legs are hard, the rest of the insect being soft and flabby, it is clear that the insect usually inhabits the soft mud, and uses its head and legs to push itself along, and to scoop out new channels and passages in the soft ooze.

We now continued our investigation by slicing out the clump A, in a direction perpendicular to the plane of the diagram. In this way we dug out a space of six feet by three feet, including the whole of C and the adjoining side of the two clumps A and B. At the further end of C, we dug out one clump of sedge-roots containing a distinctly marked passage, from which we secured a fine larva, nearly full-fed. This was the only larva we found actually in a channel, but in most cases it was impossible to dig without stirring up the mud, and disturbing everything completely. The whole space was dug out to a depth of nearly three feet, and the mud and roots carefully dredged with the net. In all, we secured seven larvæ, ranging from about half-grown to nearly full-fed. Two of these were exceedingly weak and flabby, and died soon afterwards. On examining them, I found the whole abdomen hollow, and, in one case, the alimentary canal practically destroyed: but I was unable to find the parasite that caused this, if such were the case.

After three and a half hours' work, we finished up at the part of B opposite to A in the diagram, where we found passages opening both on the top of B (b_1, in diagram) and at its side, below the water-level (b_2). These were also explored as far as possible, and the last larva was taken about a foot below the entrance of b_2.

For examination, two larvæ were taken, and killed. The gizzards of these were cut out, and carefully examined. Firstly, *as to contents*,—the only definitely recognisable portion of the food, which had not been triturated, was, *in each case*, an Agrionid labium, which I had no difficulty in recognising as that of *Argiolestes grisea* Selys. The larvæ of this little dragonfly are very common in these swamps, but not easy to obtain with a dredging-net. They cling to the matted outcrop of fine roots at the sides of the depressions in the swamps. In the diagram, the letters Y indicate the probable spots where the larva would occur. (None were actually found in C, but they are small and inert, and we were not looking for them; I have always taken them in positions akin to Y). This seems to suggest that the *Petalura* larvæ use the channels, such as a_3 and b_2, for obtaining a supply of this Agrionid larva for food. However, if that be the case, it further suggests that they are nocturnal feeders: for they are so clumsy and slow-moving that they would have no chance of capturing the *Argiolestes* larvæ in the daytime. The latter, though by no means active, are fairly quick at dodging out of sight, behind the matted roots. It seems to me, therefore, that the *Petalura* larvæ must possess a distinct advantage over them, viz., a better power of nocturnal vision. That is probably the case. It also suggests that, during the whole of the day, they must remain in the dark, horizontal mud-channels, or low down in the vertical channels—a conclusion which is justified by the positions in which we actually found them.

What then is the value of the more numerous channels, such as a_1, a_2, and b_1, opening at the tops of the clumps? These are used for the final emergence. But, as they were found in good condition on November 5th, before any of the larvæ had emerged, they must have other uses. I think it possible that the larva may undergo each ecdysis above ground, probably during the night-time. It is also very likely that they come up these channels each night, and wander about looking for food.

The only other larvæ found, while searching for *Petalura*, were five larvæ of *Synthemis macrostigma*, two small and three nearly full-fed. These lie, just covered, in the mud of the depressions. The letters X in the diagram indicate the position. It is doubtful whether the *Petalura* larvæ ever capture them, except when they are very young. Had either of those I examined been feeding on them, the labium of *Synthemis* could not fail to have appeared in its gizzard.

Structure of the teeth in the gizzard.—The second point, and by far the most important, is the arrangement of the chitinous teeth in the Petalurine gizzard. Although nearly all the larvæ taken, appeared to be very ill-nourished and flabby, yet in both the specimens examined (I selected the two healthiest) the stomach and gizzard were very large. The latter was quite 4 mm. long, of the usual bottle-shape, the neck being about 1 mm. in diameter, and the anal end quite 3 mm. This, when carefully cleaned, cut and spread out flat on a slide, stretched out into a thin, transparent membrane in the shape of a trapezium with a base of 10 mm., top 4 mm., and slant sides 10 mm., and convexly curved. No sign of teeth could be observed, either with the naked eye or with an ordinary pocket lens. Under a magnification of 25 diameters, the teeth appeared, close up to the neck of the gizzard, and very minute. They are arranged radially in eight sets, each set containing from one to six teeth, two being by far the commonest number. The two gizzards shewed remarkable variation, as may be seen by comparing the figures (Figs.2-3). In No. 1, the arrangement was 2, 2, 2, 1, 1, 2, 2, 2. In No. 2, 4, 1, 6, 4, 2, 2, 2, 2. Clearly the number 6 is abnormal. Where more than one tooth appeared in a set, the arrangement showed a distinct beginning of longitudinal chitinisation; *e.g.*, in every case except one (the sixth set of No. 2), the second tooth of a *set of two* is placed *under* the first, not alongside it. In the two *sets of four*, found in gizzard No. 2, this tendency is also shewn, for, in one case, the four teeth are arranged longitudinally; and, in the other, the top pair only are on the same level. In the figures, the teeth are drawn disproportionately large, about four times their actual size when enlarged. Their actual measurements range from 0·02 to 0·05 mm.

This simple formation of the teeth in the gizzard of *Petalura*, is of great phylogenetic interest and importance. The gizzards of the larvæ of all the more specialised *Anisoptera* possess only four sets of teeth; each set being developed on an elongated oval layer of chitin, and the whole set being spoken of as a "fold" or "field." In *Petalura*, we have no actual chitinised fields, but only a slight development of chitin round each tooth. This formation can be easily understood from the enlarged diagrams of some of the separate sets of teeth in gizzard No. 2. From this we are able to conclude that the four fields of the more specialised *Anisoptera* have been formed by the merging, in pairs, of eight simpler fields; that the teeth were developed as chitinous protuberances, on the gizzard wall itself; and that the chitinous oval field was formed later on by the extension of the chitin at the base of each tooth, so as to include finally the whole set of teeth. In the *Petalura* gizzard we can see the beginning of the formation of a chitinous field, if we look at the enlarged figures of the teeth of the seventh and eight set (Fig.4). Here the chitin surrounds both the teeth in the set.

The tendency, shewn especially in gizzard No. 2, to form a longitudinal set of teeth, is of great interest. Amongst *Anisoptera*, the longitudinal field, containing a large number of nearly equal teeth, is a characteristic of the *Gomphinæ* only. In this respect, then, we may regard *Petalura* as shewing a connection with some distant ancestor of the *Gomphinæ*. But the difference between the two forms of gizzard is far more striking than this slight similarity, and strongly bears out the claim that the *Petalurinæ* should be regarded either as a very detached subfamily, or possibly be raised to the dignity of a family.

In a kindly criticism of my former paper on the *Petalura* exuviæ, Dr. Ris pointed out to me that there was nothing remarkable about the position of the involucre of the inferior appendage in the male *Petalura* nymph, as it is interpreted by morphologists to be part of the tergite of the eleventh abdominal segment in *Anisoptera*. Hence it should be found *above* the anal opening, and not below it; and this is actually the case. As the two involucres of the superior appendages are also morphologically portions of the eleventh tergite, there is nothing really remarkable in the inferior involucre appearing *above and between them*. He also pointed out to me that I missed a point of great interest, in not studying closely the anal end of the *Petalura* nymph; for the three caudal spines usually conspicuous in nymphs of *Anisoptera*, are here reduced to small plates, which together form a *fairly distinct and compact eleventh segment*. In Fig.6 of the Plate in my former paper (These Proceedings, 1909, Pl. xxiv.) their position is not well shewn. It would be better to examine the anal end of a *female* larva, in which the involucres of the imaginal appendages take up much less room than in the male. Such a sketch, shewing the *wide-open* anal opening, with the three plates completely enclosing it (*one* superior and *two* inferior, corresponding to the three caudal spines in other *Anisoptera* larvæ) is now given (Fig.6).

The question as to whether this larva is aquatic or air-breathing, is one of some difficulty. With several of the larvæ which I obtained at Medlow, I tried the following experiments:—

(1) They were placed in a large bottle of pure water. Those which were only about half-grown, crawled about on the bottom; but the two that were nearly full-fed, rose with the tip of their abdomens uppermost, and remained with it *just on the surface* of the water, but not pushed through into the air. I noticed particularly that the water-film covered the anal opening, and that they drew water in and out when breathing. This suggests that they preferred the best aërated water to breathe in.

(2) The larvæ were all taken out of the water, and placed in a box. Here they appeared very uncomfortable, and soon became very inert.

(3) They were next placed in a tin, in about an inch of ooze from the swamp. This seemed to suit them fairly well. They moved about somewhat quickly, breathing in large quantities of the thick mud anally, and then expelling it with such force, that I could follow the stream of particles for several inches. I noticed, in particular, that they *do not* use this strong anal expulsion as a means of locomotion, in the manner of the Aeschnid larvæ. Even when at rest, the force of expulsion was very great. This suggests that their usual method of breathing is by taking in the muddy water through the anal opening, and then, having extracted the oxygen from solution, the particles of mud are expelled with great force.

A further point of interest is, to determine what means the larva possesses of filtering the muddy water which it draws in so vigorously. If the three caudal plates that surround the anal opening be carefully opened out (as in Fig.6) it will be seen that the sides of the superior plate, and the underside of each of the inferior lateral ones, are fringed with stiff hairs. When the three plates are *in situ*, I suppose that these hairs must, in some manner, interlace to form the necessary filter, keeping the rectum itself clear of all impurities in the water. When watching the larvæ breathing in muddy water, I noticed particularly that these plates are drawn so closely together as to make the anal end appear *almost closed* during *inspiration*, yet, during *expiration*, the rectum is *wide open*, just as we find it in the exuviæ. This seems to suggest that the full-fed larva, when about to emerge, and as soon as it has climbed above the water-level, keeps its rectum open for the purpose of *air-breathing*. If this be the case, Dr. Ris' conjecture that the larva is an air-breather, is seen to have some foundation in fact, but the statement needs to be modified, *viz.*, the larvæ are only *air-breathers when above water-level*. I must confess that I fully expected the larvæ, when placed in muddy water, to push their anal ends up into the air to breathe, and I was rather surprised to find that they preferred the muddy water to anything else. Still, a little reflection will show that, even if they keep their channels of communication fairly open and clean, yet these flimsy strictures must often collapse, and during periods of heavy rain it must be quite impossible for the soft, horizontal portions to hold together. I conclude, therefore, that the larva do *usually* breathe muddy water, which is filtered as described above, and that only on special occasions, namely, when foraging above water-level, or during the final ecdysis, do they breathe air.

There is one more point of interest to determine. Do the larvæ take more than one year to reach maturity? As far as I know, practically all the imagines emerge in a period covering about the latter fortnight of November. Now, of the seven larvæ taken at Medlow, three were practically full-fed, with wing-cases of greater or less size; but the other four were considerably smaller, only, one might say, about half-grown, and shewing as yet no trace of wing-cases. It seems, therefore, probable (though not absolutely proved, for these smaller larvæ might be capable of extremely rapid development) that the imago emerges in the second year from the laying of the egg.

I have not given a drawing of the mature larva, since the drawing of the exuviæ*, in my former paper, gives a fairly good representation of it. The main difference is, that the living larva appears slightly shorter and thicker, and the wing-cases are, of course, placed much more flatly along the abdomen, the hind-wing almost completely covering both the fore-wing, and the first four abdominal segments. In conclusion, I should like to express my very sincere thanks to Mr. C. Gibbons, who so kindly accompanied me on my expedition to Medlow, and by whose help this most interesting larva was discovered.

EXPLANATION OF PLATE VII.

Fig. 1.—Diagrammatic section of portion of swamp at Medlow, Blue Mountains, N. S. Wales (scale $\frac{1}{12}$), showing:—A, B, clumps of sedge; C depression or water-hole; a_1, a_2, a_3, b_1, b_2, openings of *Petalura* channels; X, X positions of larvæ of *Synthemis macrostigma*; Y, Y positions of larvæ of *Argiolestes grisea*.

Fig. 2.—Teeth of gizzard of *Petalura gigantea* larva (No. 1) (much enlarged).

Fig. 3.—Teeth of gizzard of *petalura gigantea* larva (No. 2) (much enlarged).

Fig. 4.—*a*, *b*, *c*, Teeth of the fifth, sixth and eighth fields of No. 2 gizzard, still further enlarged to show chitinisation of fields around teeth.

Fig. 5.—End of abdomen of female larva of *P. gigantea*. R, rectum—I, I, involucres of imaginal appendages.

Fig. 6.—Ditto, with the three caudal plates spread open, showing fringe of hairs.

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* These Proceedings, 1909, pl. xxiv.

THE RÔLE OF NITROGEN IN PLANT-METABOLISM.

PART iii.—THE DISTRIBUTION OF NITROGEN IN ACACIA SEEDS.

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As a large stock of the seeds of *Acacia pycnantha* was made available to the writer some time ago, the opportunity was taken to make an experimental study of the proteins and other nitrogen compounds contained in them. The seeds were in a mature condition and had been kept about two years in stock.

Preliminary Examination.—For the purpose of analysis, a quantity of the seeds, with their tightly adhering black testa left on, was crushed as finely as possible in a small mill. A portion was dried at 100° C., to ascertain the amount of moisture; the residue was incinerated and the weight of the ash noted. In another portion, the nitrogen was estimated by Kjeldahl's method. As it would be a matter of very great difficulty to separate the different parts of these seeds mechanically, it was expected that a number of different proteins would be dissolved together in the extracts. The greater part would represent the reserve proteins of the seed; and a smaller amount would be extracted from the protoplasm of the embryonic tissues.

A quantity of the finely powdered seeds was first extracted with distilled water, until very little more was dissolved. The extract was filtered clear, and the insoluble residue then further extracted as completely as possible with a 10% solution of sodium chloride. The residue obtained after filtration was next treated with alcohol of 80% strength, the alcoholic extract was filtered, and the residue then examined.

A considerable amount of nitrogen still remained in the insoluble residue of seedmeal after all these solvents had been used. The nature of this nitrogen is still unknown, although it most likely occurs in the form of protein also. The fact that, when the residue is dried and ground still finer, more protein is extracted, shows that some cells had resisted disintegration and still enclosed part of the protein. There is no doubt that tannins take an important part by combining with the protein, and forming an insoluble compound, for tannins are found in considerable quantities in the skins of Acacia seeds. Part of the nitrogen in the residue can be removed as protein by dilute alkalies and acids; but it is known, however, that these solvents alter the chemical nature of the proteins by combining with them, and that the original protein cannot again be restored. These reagents were, therefore, not applied in this case.

The distilled water and salt-extracts were each measured. One portion of each was used for the estimation of the total amount of nitrogen, and in another portion the proteins were precipitated by tannic acid; the tannic precipitates were dropped into a flask, and the nitrogen determined by Kjeldahl's method as protein-nitrogen. The results of these determinations are stated in the following table:—

TABLE i.—ACACIA SEEDS.

Water driven off at 100°C.	11·58 %
Ash	3·34
Organic constituents (by difference)	85·08
	100·000

NITROGEN IN THE VARIOUS EXTRACTS.

	in 100 gms. seeds	% of total nitrogen
Total nitrogen in the seeds	4·51 %	100
Protein N soluble in water	1·20	26·6
insol. in water, sol. in 10 % salt	0·60	13·3
sol. in alcohol 80 %	0·00	0·0
insol. in water and salt—unextracted	0·68	15·1
N of other forms sol. in water, not pptd. by tannin	2·03	45·0

It is noteworthy that a comparatively large amount of the protein is dissolved out by water alone. According to Osborne, it may contain proteoses, albumins, and globulins. From the amount of ash present, it is apparent that the addition of distilled water to the seeds is equivalent to a dilute saline solution, so that more than the real water-soluble proteins is obtained in the extract.

The alcoholic extract was treated with ether, but no precipitation followed, showing the entire absence of alcohol-soluble proteins.

It was observed that the clear saline extracts, after standing for some time, increased in acidity, and gradually deposited part of the proteins in an insoluble form. This appears to be caused by the combination of the acid and protein, forming an insoluble salt.

Osborne* has shown that a large number of proteins in plants possess more pronounced basic properties than acidic. They can easily form salts with the organic acids of the extracts. The salt-extracts were all found to be distinctly acid to litmus, and much more acid in reaction towards phenolphthalein. Now these insoluble salts of protein, formed during the extraction, may be redissolved by careful titration with sodium hydroxide, to the phenolphthalein neutral point. We then obtain the sodium salt of the organic acid, and the protein is set free in a form soluble in the saline solution. This, by the careful titration of the salt-extracts

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(*) Journ. Amer. Chem. Soc. 1902, p.89.

containing protein in suspension, much of the latter may be redissolved, and still any increase in the concentration of hydroxyl ions is avoided. This in no way resembles the conditions of extraction by dilute alkalies.

The following comparative tests were made on the solubility of the seed-proteins in various concentrations of sodium chloride, sodium hydroxide, and the two together.

Method.—Two grammes of finely-powdered seeds were extracted, for 24 hours, with the solvents stated in Table ii., and frequently shaken. All the extracts reacted acid to phenolphthalein, but alkaline to litmus. An equal volume of each clear filtered extract was then transferred to a centrifuge tube, and precipitated by the addition of 6 drops of salicyl-sulphonic acid. After spinning, the supernatant fluids were decanted, and the deposits were washed free from acid (neutral to phenolphthalein).

To each tube was then added 20 cc. of 1% saline solution, and the opalescent fluids titrated with sodium hydroxide. After titration, each was transferred to a Kjeldahl flask, and this nitrogen determined. The results are given in the table below:—

TABLE ii.

No.	Solvent		Titration $\frac{N}{100}$ NaOH	N $\frac{N}{10}$ acid
	NaOH	NaCl		
1	0·1 %		11 cc.	7·8 cc.
2	0·2		28	11·6
3	0·1	1 %	11	8·0
4	0·2	1	18	9·1
5	0·1	2	11	9·0
6	0·2	2	14	9·5
7	0·1	5	15	10·8
8	0·2	5	14	10·0
9	0·1	7	14	10·4
10	0·2	7	15	9·5
11	0·1	10	14	9·9
12	0·2	10	14	lost
13		1	4	5·2
14		5	4	7·0
15		10	4	7·9

Nos. 13, 14 and 15 show the relative amounts dissolved by salt alone, of which 10% is the best solvent. Almost the same amount of protein is dissolved by 10% salt as by 0·1% alkali. The partially neutralised extracts in the whole series, from 1% to 10%, contain more than the salt extracts alone. The maximum protein is obtained in No. 2, by using 0·2% alkali alone.

Preparation of Solutions for Analysis.—Since little is to be gained by first extracting, with water, those proteins which are also soluble in salt-solutions, the extracts were always made by adding sodium chloride solution directly to the powdered seeds.

By extracting 20 gms. of seeds with 1 litre of 10% sodium chloride solution for 1 day, an extract was obtained in which the protein-content was determined by precipitation with tannic acid, and the estimation of nitrogen in the precipitate. The residue of seeds was again extracted with a second litre of salt-solution, and the amount of protein-nitrogen estimated as before. By successive treatments in this way, until no protein was contained in the final solution, the maximum quantity of protein capable of being extracted by sodium chloride solution was ascertained. The results were as follows:—

1st	Extraction	yielded	76 %	of	the whole	extractable	protein.
2nd	,,	,,	14	,,	,,		,,
3rd	,,	,,	6	,,	,,		,,
4th	,,	,,	2	,,	,,		,,
5th	,,	,,	1	,,	,,		,,
6th	,,	,,	0·6	,,	,,		,,
7th	,,	,,	0·3	,,	,,		,,

In consequence of the above, the numerous single extracts made for various experiments, give results which are not comparable with one another.

In order to study the behaviour of these proteins towards the different reagents, an extract was made from 100 gms. of seeds in 10% sodium chloride solution, which contained 3·05 gms. of nitrogen.

(*a*) To 50 cc. of the extract, were added 10 drops of a 2% solution of acetic acid, then heated to boiling in the water-bath for some time. The coagulated protein was filtered; the filtrate was boiled for some time longer, and the small amount of precipitate obtained was added to the first. The coagulum, after washing with hot water, was Kjeldahled for nitrogen. The filtrate from the coagulated protein showed no biuret reaction, indicating absence of peptones. On titrating with alkali till neutral to phenolphthalein, no precipitate was observed.

(*b*) Fifty cc. of the extract were precipitated by a 5% tannic acid solution, and kept cool by standing in water; after spinning in a centrifuge, and washing with diluted reagent, the nitrogen was estimated.

(*c*) Fifty cc. of the extract were diluted with water to 250 cc., and a rapid current of carbon dioxide passed through it for some time. The precipitate was separated in the centrifuge. The fluid, after further diluting with an equal volume of water, was again treated with the gas, when a small precipitate was obtained, which was added to the first, and the nitrogen estimated. The filtrate was further tested by boiling, when a coagulum formed, which was removed, and its nitrogen also estimated.

The results are stated below:—

TABLE iii.

	N gms.	% of the total N of seeds
Seeds, 100 gms. contain	4·51	100·
Salt-extract contains	3·05	67·6
(*a*) Coagulum by boiling	1·064	23·6
(*b*) Tannic acid ppt.	1·350	30·0
(*c*) CO_2 precipitate	0·851	18·9
Filtrate coagulated by heat	0·132	2·9
Filtrate not coagulated	2·041	45·3

A second extract was obtained as before, with 10% sodium chloride solution, and further precipitations made for comparison:

(*a*) Coagulation on boiling, (*b*) tannic acid ppt., as before,

(*c*) Trichloracetic acid added to the extract, which was then heated to boiling point, and filtered hot. The filtrate was then allowed to cool, whereupon it became cloudy, and deposited a further precipitate. On boiling once more, this deposit redissolved, and was again obtained on cooling. The nitrogen in each was estimated separately.

(*d*) Saturation with sodium chloride till the protein was salted out; after remaining some time with excess of salt still visible, it was separated by the centrifuge, and its nitrogen estimated. (*e*) Phosphotungstic acid was added to the filtrate from the tannic acid precipitation, after acidifying with sulphuric acid. In the protein-free filtrate, phosphotungstic acid precipitates the basic nitrogen compounds,—cholin, histidin, arginin, &c., if present.

The results are given in the following table:—

TABLE IV.

	N gms.	% of total N of seeds.
Seeds, 100 gms. contain	4·510	100·
Salt-extract contains	1·670	37·0
(*a*) Protein coagulated by heat	0·448	9·9
(*b*) ,, pptd. by tannic acid	0·629	14·0
(*c*) ,, ,, by trichloracetic hot	0·516	11·45
Deposited on cooling after (*c*)	0·075	1·65
(*d*) Protein salted out with saturated NaCl.	0·093	2·06
(*e*) Pptd. by phosphotungstic acid from tannin filtrate	0·317	7·1

Taking tannic acid, which yields the maximum protein-precipitate as a standard, it is seen that the protein coagulated by boiling is in both experiments considerably less, in fact only about 75% of the tannic acid precipitate. This shows how imperfectly plant-proteins are coagulated, even on boiling for a considerable time. The acid added no doubt plays a considerable part in the denaturing, for if an extract be previously neutralised to phenolphthalein with alkali, and then boiled, scarcely any coagulation takes place. When a 1% sodium chloride extract is heated very slowly, coagulation begins about 65° C., and the solution is distinctly acid. The protein has formed a compound with the acids during the extraction, and the conditions are then assured for heat-coagulation. The precipitate obtained by carbon dioxide in a dilute saline solution is now considered to be composed entirely of globulins. The extent of dilution necessary is of great importance. In this case, 10 vols. of water were required for complete separation. The nitrogen is equivalent to 63% of the tannic acid nitrogen.

Trichloracetic acid is usually stated as a precipitant for globulins, albumins, and proteoses. The latter, however, may be kept dissolved by boiling and filtering the liquid hot. The filtrate, after cooling, deposits these proteoses, which may then be separated from the perfectly cold liquid by filtration. This small deposit easily redissolved on boiling with water, and was as easily recovered by cooling. It amounted to 1·6% of the total nitrogen. By saturation of the extract with sodium chloride, a very small amount of protein is salted out. Finally, phosphotungstic acid was used to precipitate the basic constituents of the non-protein part. It was not used as a protein-precipitant.

A number of attempts were made to dialyse a solution of proteins obtained by salting out with ammonium sulphate, but it was not found an easy task to completely prevent the changes due to fungoid and bacterial contamination from taking place, and they had to be abandoned. The proteins on being salted out by complete saturation with ammonium sulphate, only partially went into solution again, when the precipitate was diluted with water. The figures obtained for albumins and globulins were, therefore, not reliable, and are omitted.

The following table gives an approximate view of the precipitation-limits with ammonium sulphate, of the proteins present in a 10% salt-extract.

TABLE V.—FRACTIONAL SATURATION WITH AMMONIUM SULPHATE.

No.	Salt extract.	Saturated Am. Sulp.	Water.	Result.
1	2 cc.	0 cc.	8 cc.	No ppt., faint
2	2	1	7	,, opalescence
3	2	2	6	,, ,,
4	2	3	5	,, ,,
5	2	4	4	,, ,,
6	2	5	3	,, ,,
7	2	6	2	Pptn. begins, clear fluid
8	2	7	1	Large ppt. ,,
9	2	8	0	Larger ppt. ,,

Each of the nine tubes contained 10 cc. of fluid. Successively increasing amounts of ammonium sulphate were used, and the point observed at which incipient precipitation took place. This occurred in No. 7, with six-tenths saturation. With a lower concentration, no salting out occurred, and above this point the precipitation rapidly increased.

Quantitative Precipitation by Alcohol.—Alcohol precipitates globulins, albumins, proteoses, and peptones, in the order named. Animal-peptones are stated by Mann to be partly soluble, even in 96% alcohol, though Kühne and Chittenden observe that the precipitation is much more complete in the presence of salts. As plant-proteins vary considerably in the strength of alcohol required for their precipitation, the following series of experiments was designed to ascertain if any difference could be detected in the various fractions obtained by gradually increasing strengths of alcohol. For this purpose, a protein-extract was prepared with 5% sodium chloride, and filtered clear.

(*a*) Of this solution, 20 cc. were placed in each of eight centrifuge-tubes, and the calculated proportions of alcohol and water added so that, maintaining the same volume of liquid throughout, the strength of spirit ranged from 10 to 80%. These tubes were allowed to stand over night to deposit, then spun in the centrifuge. After decantation of the superfluid, the deposits were transferred to small, accurately weighed centrifuge-tubes, washed once with alcohol of the same strength, followed by two washings with absolute alcohol, and finally with dry ether. The tubes were next dried carefully at 50° C. in the oven, finally at 110° to constant weight, and weighed under exact conditions. The contents of each tube were then shaken out into a weighed platinum crucible, and the tubes reweighed. The dry white powder was incinerated, and the weight of the ash determined. The weight of ash-free protein was thus obtained.

(*b* In a precisely similar series of duplicates precipitated under the same conditions, as nearly as possible, the moist deposits, after washing with alcohol of the same strength, were each transferred to a Kjeldahl flask, and the nitrogen estimated.

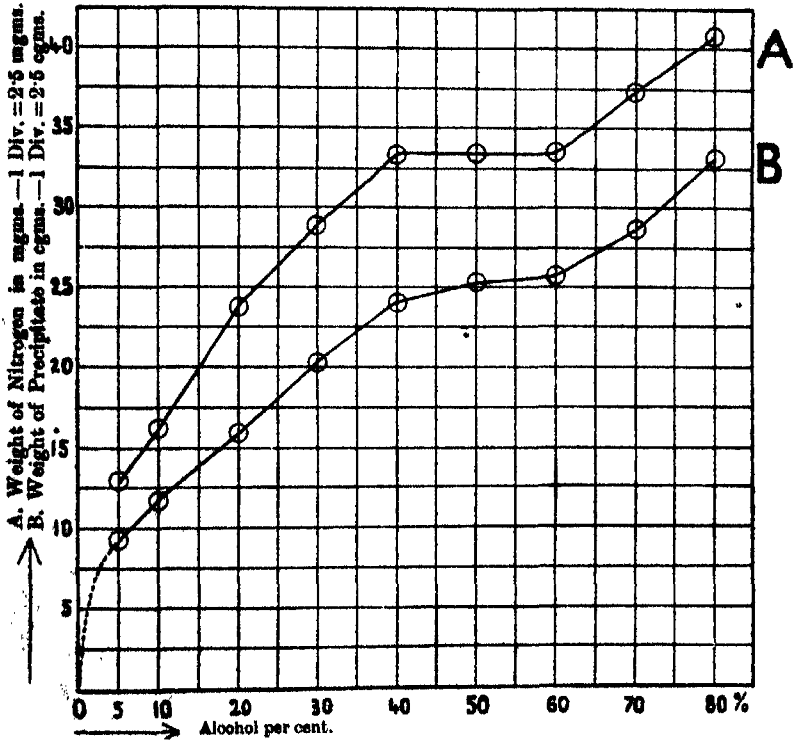
The details of these experiments are tabulated below:—

TABLE vi.

No.	Alcohol present.	Preparation.			Wt. of deposit.	Ash.	Ash. free protein.	Nitrogen.
		Extract	95 % Alcohol	Water.				
	%	cc.	cc.	cc.	gm.	gm.	gm.	gm.
1	5	20	6·5	100	0·0916	...	0·0916	0·0131
2	10	20	13·5	93·5	0·1188	0·0020	0·1168	0·0164
3	20	20	27·0	80·0	0·1600	0·0024	0·1576	0·0241
4	30	20	40·5	66·5	0·2055	0·0024	0·2031	8·0289
5	40	20	54·0	53·0	0·2450	0·0050	0·2400	0·0335
6	50	20	67·5	39·5	0·2600	0·0072	0·2528	0·0347
7	60	20	81·0	26·0	0·2657	0·0088	0·2569	0·0335
8	70	20	94·5	13·5	0·3035	0·0166	0·2869	0·0375
9	80	20	107·0	0	0·3606	0·0296	0·3310	0·0407

These results are plotted in the accompanying curves, of which the ordinates represent—in A, the weights of nitrogen in milligrams; and in B, the weights of precipitate in centigrams. Abscissæ represent the percentages of alcohol present.

The nitrogen-curve, A, indicates the existence of more than one distinct protein. The first and least soluble protein has begun to precipitate with 5% alcohol, and, at this low concentration, nearly one-third of the total protein in the extract is precipitated. From the initiation, up to 40% alcohol, the amount of this protein precipitated is roughly proportional to the concentration of the alcohol. At the limits of 40 and 60%, distinct changes in the solubility are observed, and practically the same amount of nitrogen is precipitated. At the latter stage, both curves rise suddenly,



and run approximately parallel to the end. The latter part of the curve consists of the protein or proteins most difficult to precipitate by alcohol.

With a concentration of 55% and upwards, of alcohol, the gums present in the extract are precipitated with the protein, and their influence on the percentage of nitrogen in the latter part of the curve is noticeable. The two curves of precipitate and nitrogen, however, run approximately parallel throughout.

As will be seen from the foregoing Tables, in addition to the proteins existing in the saline extracts, there is a considerable amount of nitrogenous compounds in a form other than protein.

N in form of soluble proteins	40 %
N *left in residue of seeds*	15
N in non-protein form	45
% of the total N in the seeds	100

The following experimental studies are devoted to the elucidation of the nature of this 45% of the nitrogen of the same Acacia seeds. The solutions were prepared in different ways, and the results are all stated in per cent. of the non-protein nitrogen, taken as 100.

(1) *Preparation of the solution*—Method (*a*). The powdered seeds were extracted as completely as possible with cold water. After filtering, the liquid was concentrated on a water-bath to about a litre; the coagulated proteins were removed, and the remaining proteins precipitated by tannic acid. The latter reagent was removed from the solution by lead acetate, the lead by sulphuric acid and hydrogen sulphide, and the excess of the latter by a current of air.

Method (*b*). The seeds were extracted as completely as possible by hot water, and the solutions filtered. The combined fluids were concentrated, and poured into alcohol, making a solution of 80% in strength. After standing over night, the proteins were filtered off. The clear alcoholic fluid was distilled, and the remaining aqueous solution diluted with water to a definite volume.

(2) *The solution tested by protein-reagents*:—

Millon's reagent,—very faint positive reaction after boiling.

Heller's nitric acid test,—nil.

Xanthoproteic, boiling nitric, then ammonia,—exceedingly faint yellow.

Ehrlich's diazo-reaction,—doubtful, perhaps slightly positive reaction.

Biuret test,—negative.

Salicyl sulphonic acid—negative.

Salicyl sulphonic acid—in filtrate after saturation with ammonium sulphate,—no ppt.

Lead acetate—no ppt.

Phosphotungstic acid,—large white ppt.

Mercuric nitrate—bulky white ppt.

The solution is, therefore, practically protein-free, and the reactions of Millon's and Ehrlich's solutions show that only a trace, if any, of tyrosin or histidin can be present. A large amount of basic substances is indicated by the precipitate with the alkaloidal reagent phosphotungstic acid; and this may, of course, include certain lesser polypeptides which do not contain a biuret reacting group.

(3) *The distribution of the nitrogen.*—A solution of the non-protein nitrogen compounds was prepared by method (a), and examined in the following manner:—

(i.) The total amount of nitrogen was ascertained.

(ii.) A portion was set aside under a bell-jar with milk of lime, for the Schlösing estimation of ammonia; while another portion was distilled with magnesia in a current of steam, and the ammonia collected in decinormal acid. The Schlösing method gave small and variable results, and was discarded. When the solution is boiled with magnesia, a very slow evolution of ammonia begins; it continues slowly, hour after hour, and does not seem to come to a definite end in a reasonable time. After twenty minutes boiling, about 1 cc. of decinormal ammonia had collected; and, after four hours, 5 cc.; it was then distilling at the rate of 0·4 cc. per hour. (In a control, it was found that the whole of the ammonia from 0·6 gm. of ammonium chloride was distilled in less than twenty minutes, at the same rate of boiling; and required over 100 cc. decinormal acid.) One must conclude from this, that the ammonia does not all exist preformed in the solution, but is evolved from a substance which slowly decomposes by the action of magnesia, when boiled.

(iii.) The original solution was next treated with phosphotungstic acid, and the precipitate of basic compounds assayed for nitrogen. A phosphotungstic precipitation was also done on the solution, previously boiled with magnesia for four hours.

(iv.) The phosphotungstic filtrate from the former was distilled with magnesia, while a part was hydrolysed by boiling, for two hours, in 10% HCl, then neutralised, and distilled with magnesia.

(v.) The phosphotungstic filtrate from No. i., was examined for amino-groups by the sodium hypobromite method. The phosphotungstic acid was removed as barium salt, and excess of barium precipitated by carbon dioxide. The nitrogen evolved by the hypobromite was measured in a eudiometer.

The order of the experiments is indicated thus:—

Magnesia distillation (ii.) —> phosphotung. (iii.) —> sod. hypobromite (v.)

$$\text{Phosphotungstic (iii.)} \longrightarrow \begin{cases}\text{distillation (iv.)}\\ \text{hydrolysis and distillation.}\end{cases}$$

The percentage of nitrogen obtained in each of the above determinations, is set out in the following table:—

TABLE vii.

		N.
(i.)	Total nitrogen in the protein-free solution	100·0
(ii.)	Ammonia evolved in the cold by lime water	2·8
	,, distilled with magnesia	9·9
(iii.)	Pptd. by phosphotungstic acid after distilln.	18·2
(v.)	Sod. hypobrom. in phosphotung.-filtrate after distilln.	19·3
	Undetermined	52·6
(iii)	Phosphotungstic ppt. in orig. solution	20·2
(iv.)	,, filtrate distilled with magnesia	1·13
	,, ,, hydrolysed and ,,	4·23

(4) The next series was carried out on a solution obtained by method (*b*), protein precipitated by alcohol.

The following diagram will serve to show the order of the experiments.

↗nitrous acid.
Hydrolysis and distn. —>—hydrolysis and distn. —>nitrous acid.
↘phosphotung.

(i.) The solution was hydrolysed by boiling in 8% hydrochloric acid, for two hours, neutralised, and distilled with magnesia, and titrated every hour.

TABLE viii.

After	1st hour	8·07 %
	2nd ,,	0·66
	3rd ,,	0·46
	4th ,,	0·41
	4 hours.	9·6 % of the N.

(ii.) The same solution was then hydrolysed a second time in 8% hydrochloric acid, for two hours, and the distillation with the magnesia repeated.

TABLE ix.

Distilled	½ hour	5·2 %
	½ ,, longer	1·2
	½ ,, ,,	0·8
	½ ,, ,,	0·8
		8·0 % of the N.

(iii.) The above hydrolysis, with 8% HCl, was accompanied by a considerable blackening of the solution, due to the formation of melanoidin. After the first hydrolysis, the residue in the retort from the distillation was dissolved in sulphuric acid, and allowed to stand. The black precipitate was filtered off. It contained 4·8% of the nitrogen.

(iv.) The solution, after these two distillations, was now used for the estimation of amino-groups; and, first, the sodium hypobromite method was tried, with entirely negative results. That is, after acid hydrolysis and distillation of the ammonia formed, those substances are destroyed, which had previously liberated nitrogen gas with this reagent.

The nitrous acid method of Sachsse and Kormann was then applied.

The apparatus gave the theoretical yield of nitrogen from a sample of pure asparagin. Portion of the solution, after the first hydrolysis and distillation, was treated by the above nitrous acid process, and gave, after all the necessary corrections were made, 65·7% of the nitrogen. The solution, after the second hydrolysis and distillation, yielded, in the same way, 38·8% of the nitrogen.

(v.) After the first hydrolysis and distillation, the solution was treated with phosphotungstic acid for basic substances, and the precipitate contained 14·1% of the nitrogen.

The results obtained from this series of experiments may now be tabulated as under:—

TABLE X.

	Total nitrogen in the protein-free solution	100
(i.)	Hydrolysed and distilled with magnesia	9·6
(iii.)	Melanoidin formed by above hydrolysis	4·8
(ii)	Second hydrolysis, distilled with magnesia	8·0
(iv.)	Nitrogen evolved by sodium hypobromite	nil
	Half nitrogen evolved by nitrous acid	38·8
	Undetermined N	38·8
(i.)	First hydrolysis and distillation with magnesia	9·6
(v.)	Precipitated by phosphotung. after hydrolysis and distilln.	14·1
(i.)	First hydrolysis and distilln. with magnesia	9·6
(iv.)	Half N evolved by nitrous acid after hydrol. and distilln.	65·7

(5) Seeing the effects of two successive hydrolyses, in decomposing certain of the constituents, to be so marked, the following series was designed to show the effect of varying the conditions of hydrolysis. For this purpose, a solution was obtained by the method described in paragraph 1 (b), and was further treated in the following manner. The liquid was made to contain 5% (by weight) of sulphuric acid, and a solution of phosphotungstic acid was added till no further precipitate formed on standing. The clear fluid was decanted, and the rest separated by the centrifuge, the precipitate being washed with the dilute reagents. From the fluid, the reagents were removed by baryta in slight excess, and the latter by carefully titrating with sulphuric acid, till the colour with phenolphthalein was just removed. After filtration, the clear pale yellow fluid was divided into five equal portions for hydrolysis, as follows:—

a. Boiled for 1 hour with 8% (by wt.) hydrochloric acid.
b. ,, 2 hours ,, 8 ,, ,,
c. ,, 4 ,, ,, 8 ,, ,,
d. ,, 8 ,, ,, 8 ,, ,,
e. ,, 15 ,, ,, 25 ,, sulphuric acid.

The hydrolysed fluids were then each neutralised, and distilled with magnesia by a current of steam into standard acid. The distillate was titrated after every hour, for four consecutive hours, and gave the following figures:—

TABLE XI.

	a.	*b.*	*c.*	*d.*	*e.*
After 1st hour	9·41%	10·38%	11·86%	13·73%	24·6%
,, 2nd ,,	1·00	0·86	0·72	1·29	3·2
,, 3rd ,,	0·72	0·43	1·00	1·00	2·3
,, 4th ,,	0·72	0·43	0·28	0·43	0·9
	11·85	12·10	13·86	16·45	31·0%

per cent. of the non-protein N in the extract.

Results.—In the above extract, after phosphotungstic acid precipitation, the process of hydrolysing decomposes some of the constituents, with the liberation of ammonia. The quantity of ammonia set free increases with the length of time the solution is boiled, and also with the strength of the acid used. Secondly, the titrations, after distilling for four hours, are still yielding much ammonia, and, no doubt, would have continued for many hours longer, so that even the last result of 31% is not at all the maximum figure obtainable.

Thirdly, the ammonia which distils is not all preformed in the solution; after the first hour, all preformed ammonia must have been evolved, and the solution, by the continued boiling with magnesia, still liberates ammonia slowly, and in gradually lessening quantity. This is not characteristic either of amides or amino-acids.

However, the residual fluids in the distillation flasks were now examined for compounds possessing the amino-group. The apparatus for the nitrous-acid method of Sachsse was used as in a former operation. In the majority of these determinations, no nitrogen was evolved. In a few, a small amount only was obtained, which would account for less than 0·5% of the non-protein nitrogen.

The same residual fluids, after distillation with magnesia, were next submitted to the Sörensen* titration.

In this, the solution is titrated with one-fifth normal sodium hydroxide, before and after treatment with neutral formaldehyde. In the first stage, free acid and also those carboxyl groups which are distant from an amino-group are neutralised; and, in the second stage, the formaldehyde removes the *amino-group*, and with it *disappears* the protective influence of the latter on the α carboxyl-group, thereby making the carboxyl-group available in the second titration.

Results.—Solutions *a*, *b*, *c*, *d*, *e*, when titrated, were found to be neutral. After addition of the formaldehyde solution, they still remained neutral. From these results we should conclude that compounds containing the amino-group were absent.

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* Biochem. Zeitsch. 7, 1907, s.45.

The solid content of the protein-free extract.—A portion of No. 4 extract, after precipitation of the proteins with alcohol, was taken, to ascertain the amount of total solids present in it. Fifty cc. were evaporated *in vacuo* over sulphuric acid at ordinary temperature, and dried, over $CaCl_2$, in a vacuum desiccator, to constant weight. The residue was equivalent to 20%, by weight, of the seeds. A larger volume also was evaporated at a gentle heat to a syrup, then put aside for some time to crystallise. After the lapse of a few weeks, it was still a clear yellow syrup showing no signs of crystal-formation. However, on examining it some months later, with a lens, it was observed to contain numerous tyrosin-like clusters or groups of radiating needles. These minute crystals did not possess the opaque white appearance so characteristic of tyrosin, and gave a negative Millon reaction. The residue was then a tough and horny mass.

Another portion of the same solution, No. 4, was precipitated by mercuric nitrate. From the precipitate, the mercury was removed by hydrogen sulphide, and the liquid evaporated, at a very gentle heat, to a syrup, then set aside. After standing many weeks, no crystallisation had taken place, the substance remaining as a clear dark syrup.

A part of the same solution, No. 4, was then examined for lipoids, by shaking out with pure ether, a number of times. The ethereal liquid was dried with calcium chloride, then evaporated to dryness, and the residue weighed. It amounted to 0·546%, by weight, of the seeds. By assuming the whole of this ether extract to be lecithin (which contains 1·78% of N), the nitrogen required would be 0·0097, a quantity which amounts to just 0·48% of the non-protein nitrogen. It may, therefore, safely be concluded that the possible lecithin-nitrogen does not exceed 0·5% of the whole non-protein nitrogen present.

DISCUSSION OF RESULTS.

i. The Proteins.

Solubility.—The seeds of *Acacia pycnantha* contain 4·5% of nitrogen, partly in the form of protein, and partly as other nitrogenous compounds. Table i. shows that, of the total nitrogen, over 70% can be extracted from the seeds by water, and 13% by sodium chloride. By extracting as completely as possible with 10% salt solution, and treating with a 5% tannic acid solution, the proteins precipitated correspond to 40% of the nitrogen, and the filtrate contains 45% nitrogen as non-protein compounds. The solubility of the proteins in salt-solution is greatly increased by nearly neutralising to phenolphthalein. In Table ii., are given the relative amounts of protein extracted by sodium chloride from 1 to 10%, alone, and with alkali added till nearly neutral.

	Alone.	With 0·1 % alkali.
Sodium chloride 1 %	5	8
10 %	8	10
Sodium hydroxide 0·1 %	8	

The same amount is extracted by 0·1% alkali as by 10% salt.

An extract of the seeds in 10% salt-solution filtered clear, slowly becomes acid to litmus, and deposits protein on standing. According to Osborne, an insoluble salt is formed of the basic proteins with the free acid of the extract.

Action of various precipitants.—From a 10% salt-extract, the following reagents precipitate the proteins in decreasing amounts, in the order given, and in the following relative proportions:—

Tannic acid	14· % of the total N
Trichloracetic acid	11·5
Heat coagulation	10·
Carbon dioxide	9·
Sodium chloride saturation	2·

A 5% tannic acid solution was added to the 10% salt-extract till no further precipitation took place, avoiding excess. The solutions were kept cool by standing in water. This reagent precipitates the largest amount of protein, and the filtrates were biuret-free. With regard to the nature of this protein, the following authorities are quoted:—

Sebelien,[*] 1889, prepared proteins by salting out egg-albumin, casein, etc., and found that these were completely precipitated from solution by tannic acid, giving nitrogen-free filtrates. He used a solution of tannic-acetic acids and alcohol.

Effront,[†] 1899, showed that the end-products of peptic digestion of fibrin escape precipitation with tannic acid, and that, besides peptones, some albumoses remain in solution.

Neumeister[‡] states that this reagent precipitates all proteins, including proteoses and peptones.

Simon,[§] separated the total proteins of milk completely by a solution of tannic-acetic acids and alcohol, but found that, with tannic acid alone, quantitative results could not be obtained; also that good results ensued only when sufficient inorganic salts were present.

Hedin,[‖] 1904, by using a tannin-salt-acetic acid solution, showed that the amount precipitated varied with the concentration of the protein-solution; and further, that the tannin-filtrate contained peptones and lower products of digestion.

Mack,[¶] 1904, after preparing pure peptones by Siegfried's method, showed that they were precipitated from strong solutions by tannic acid, the precipitates being soluble in acetic acid.

Winterstein and Bissegger[**], 1906, used the tannic-acetic acid-alcohol-mixture to precipitate the total protein of cheese-extracts, and found that the results were influenced by the amount of tannic acid used, and that the presence of sodium chloride makes separation more complete.

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[*] Sebelien—Zeit. physiol. Chem. 13, 1889, 135.

[†] Effront—Chem. Ztg., 24, 1899, 770, 788.

[‡] Neumeister—Lehrb. d. physiol. Chem. ii., 234.

[§] Simon—Zeit. physiol. Chem. 33, 1901, 470.

[‖] Hedin—Journ. Physiol. 30, 1904, 156, 195.

[¶] Mack—Zeit. physiol. Chem. 42, 1904, 259.

[**] Winterstein u. Bissegger.—*ibid.* 47, 1906, 36.

Mey *, 1906, found, in the tannin filtrate from peptic digests, numerous peptone-like substances giving the biuret reaction.

Bigelow and Cook †, 1906, by numerous experiments, determined the conditions of maximum precipitation for Witte's peptone to be concentration of tannic acid 5%, sodium chloride 15%, in the final solution in which precipitation is made. This gave the maximum precipitation of proteins, and separated 94% of the nitrogen of Witte's peptone. This reagent precipitated proteoses and peptones at 12°C.

Suzuki ‡, 1907, employed a tannin-salt solution in his experiments on germinating seeds, to separate total proteins, including peptones.

Bialosuknia §, 1908, and numerous other workers in plant-proteins, measure the activity of proteolytic enzymes by the increase of nitrogen in the tannin filtrates.

These references suffice to show the uncertainty which existed with regard to the completeness of the precipitation by tannic acid. There is no doubt concerning the true proteins, as Sebelien showed, their precipitability being complete when the correct conditions, as to the amount of reagent and concentration of protein, are found for each case, conditions which vary with the nature of the protein. But, in dealing with protein-derivatives, there is now sufficient evidence to show,, that many of the polypeptides are redissolved by excess of the reagent, so that the filtrates may give a positive biuret reaction. Since the polypeptides may exist in decreasing molecular magnitude, from the very complex to the simple dipeptides, it would appear useless to fix any limits as to which are, and which are not precipitated. But it is quite certain that the smaller members are soluble.

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* Mey—*ibid.* 48, 1906, 81.

† Bigelow & Cook—Journ. Amer. Chem. Soc. 28, 1906, 1485.

‡ Suzuki—Journ. Biol. Chem. iii., 1907, 268.

§ Bialosuknia—Zeit. physiol. Chem. 58, 1908, 487.

The trichloracetic acid figure is less than that for tannic acid. Most proteoses and peptones are soluble in this reagent. Distinct evidence of proteoses is given in Table iv., by the deposit formed on cooling the hot filtrate; this deposit redissolves on heating. Proteoses are only partially precipitated by excess, dissolve on boiling, and re-appear on cooling, while peptones are not precipitated.*

The protein coagulated by boiling the salt extract, slightly acidulated with acetic acid, is considerably less than the tannin-precipitate. The results of Osborne, Chittenden and Mendel†, show that coagulation of reserve-proteins of seeds is always incomplete, and that their behaviour is wholly different from that of animal-proteins. On this account we cannot designate the uncoagulable protein, which is precipitated by tannic acid, as proteose and peptones, which is so often done in the separation of animal-proteins.

Carbon dioxide precipitates a little over one-half (63%) the amount obtained by tannic acid. This probably represents the actual globulins present.

A very small quantity only is obtained by complete saturation with sodium chloride.

By fractional salting out with ammonium sulphate, precipitation begins with six-tenth's saturation. The globulins, which are most readily salted out, appear first; and since we have seen that carbon dioxide shows the presence of at least 63% of globulins, they must constitute the whole of the seven-tenth's fraction, and part of the eight-tenth's. All the work done on the globulins, up to within a few years ago, was based on the fact that globulins were defined as those proteins which could be salted out by half-saturation with ammonium sulphate—a definition very far removed from the truth, and according to which the extract would contain no globulins at all.

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* Martin, C. J., Journ. Physiol. 15, 1894, 375.

† Journ. Physiol. 17, 1894, 48.

By quantitative precipitation with alcohol, in increasing successive concentrations, a differentiation occurs into at least two distinct proteins. The precipitation of the first runs approximately proportional to the concentration of alcohol, from the commencement to 40%. From 40 to 60% the nitrogen is nearly constant, and a second protein is indicated at 60% concentration, by the sudden change in the solubility of the precipitate, and the increase in amount of nitrogen.

ii. The non-protein Nitrogen Compounds

The experimental work may be grouped under the following headings:—

A.—Preparation of a protein-free solution containing other nitrogen compounds, and proof of absence of protein.

B.—Distillation of free ammonia in the solution.

C.—Hydrolysis by dilute acids under a reflux condenser, and subsequent distillation with magnesia, by Sachsse's method for amides.

D.—Continued and drastic hydrolysis, involving decomposition of substances which yield more ammonia than C.

E.—Precipitation of basic constituents with phosphotungstic acid.

F.—Examination for compounds containing the amino-group.

A.—The non-protein nitrogen solutions are obtained by two methods. (a) Cold saline extracts are precipitated by tannic acid, lead acetate, and hydrogen sulphide. (b) Hot distilled water extracts are precipitated in 80% alcohol. The alcohol containing the non-protein constituents is distilled under reduced pressure, the aqueous residue diluted with water, and filtered. Evidence is shown that these solutions are practically protein-free. The solutions contain no nitrates and no alkaloids, and when distilled no nitrogen is found in the distillate.

B.—Ammonia is obtained from all the extracts by distilling with magnesia in a current of steam. Zymolysis during the extraction of the seeds, with its consequent liberation of ammonia, is entirely excluded in method (b) by boiling. That this ammonia is actually free in the extracts, is doubtful, since the desamidising enzymes of seeds do not become active till germination begins. There remains then the probability that compounds are present, which decompose with great ease by distilling with magnesia. In support of this, we have (in Table vii., iv.) the result of a distillation, following the removal of all pre-existing ammonia, and other basic compounds, with phosphotungstic acid: ammonia is formed as before. Again, when distilled directly (Table vii., ii.), and after hydrolysis with dilute acid (Table x., i.) practically equal quantities are obtained in the same time.

C.—By hydrolysing with dilute acids, amides split off ammonia with great readiness, which distils off rapidly with magnesia. In Tables viii. and xi.*a*, the minimum figures are obtained under conditions well known to yield the whole of *amide-ammonia*. These are about 8-10% of the *non-protein* nitrogen, and would represent about 2% of asparagin in the seeds. On the other hand, when the attempt is made to isolate amides by Schulze's method with mercuric nitrate, only a syrupy residue is left, which shows no crystallisation on long standing. Again, the magnesia distillations, instead of coming to a sharp finish, apparently go on for some considerable time, evolving ammonia (Table xi.), as if it were gradually formed by the slow decomposition of substances other than amides. In consequence, the invariable procedure of ascribing to amides, this ammonia obtained by Sachsse's process, can certainly not be applied here.

D.—By increasing the duration of hydrolysis, and strength of acid, the decomposition is accelerated, with an increased liberation of ammonia. Boiling with 25% sulphuric acid, for 15 hours, results in the formation of 31% of ammonia-nitrogen. Even after this powerful treatment, the ammonia distillation is drawn out for some hours, as is seen in Table xi., *e*.

E.—The phosphotungstic precipitates, when dissolved, and the reagent removed with barium hydroxide, begin rapidly to decompose; and, within a few days, considerable volumes of trimethylamine are liberated. This strong evidence of the presence of cholin is partly confirmed by subsequently obtaining the characteristic haemin-like crystals of cholin per-iodide, which are recognised under the microscope in abundance. That this free cholin has not its origin in lecithin or other lipoids occurring in the extract, is seen from the small amount of lecithin, 0·5%, obtained by ether-extraction. Both cholin and betain have been identified by Schulze in leguminous seeds.

The same solution gives, with silver sulphate, a considerable precipitate containing xanthin-bases, and, after saturation with baryta, a precipitate which probably contains arginin. The total nitrogen-value of these basic compounds is 20% of the non-protein nitrogen, but when the phosphotungstic precipitation follows hydrolysis, only 14% is obtained. The difference is mostly accounted for by the formation of a large amount of melanoidin, which is explained by Samuely* as probably due to the association of the nitrogenous compounds with carbohydrates present in the solution, and their oxidation during the hydrolysis with acid. Schmiedeberg† noticed also that xanthin bases and carbohydrates gave rise to melanoidin, when boiled with acids.

F.—In the examination of the solution for compounds containing the amino-group, the following results were obtained:—

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* Hofmeister's Beiträge, 1902, s.355.

† Arch. f. exp. Path. u. Pharmak., 43, 1899, s.57.

	Sodium hypobrom. N.	Nitrous Acid N.
After:—		
1. Magnesia dist. + phosphotung. acid......	19·3 %	
2. Hydrolysis and distillation..................	nil	65·7
3. Hydrolysis + hydrolysis and distilln...		38·8
4. Phosphotung. + hydrolysis and distilln.		0--0·5
	% of the	non-prot. N.

Of the compounds known to evolve nitrogen gas with sodium hypobromite, ammonia and basic compounds are excluded in 1, and only certain amides are left to represent the 19·3% *of nitrogen. In* 2, amides also are excluded and no nitrogen was obtained. Although the two plant-amides, asparagin and glutamin, do not evolve ammonia with hypobromite till hydrolysed with dilute acids, yet this does not exclude the existence of other compounds in which the amino-group is in a less stable position, and which would evolve ammonia, like urea, allantoin, etc., with this reagent. It is significant that the nitrogen in 1, and that obtained by Sachsse's method after prolonged hydrolysis (Table xi. *d*), and which has been already discussed as a possible amide-figure, are approximately the same. This reagent does not liberate nitrogen from amino-acids.

Nitrous acid, on the other hand, decomposes almost all amino-groups with evolution of nitrogen. After hydrolysis, such compounds must be present, representing the high figure in 2. After a double hydrolysis, the nitrogen evolved by nitrous acid is reduced to about one-half, and, following phosphotungstic acid and hydrolysis, no nitrogen is obtained.

Amino-acids.—Van Slyke[*] found that no nitrogen was evolved from prolin or glycin anhydride which contain the imino-group; also that guanidin, creatin, and the amide-group of asparagin, do not react. Slyke and Hart[†] have shown that amino-acids, boiled with magnesia, do not evolve ammonia. Kruger and Schmid* heated amino-acids with concentrated sulphuric acid at 160° C., and showed that no ammonia was given off on distillation with alkali. Now 2 and 3 show that the nitrogen is obtained from compounds which are rapidly decomposed by hydrolysis, and 4 that, after removal of basic compounds, the hydrolysis and distillation remove these readily decomposable compounds almost entirely. We can, then, only conclude from the above that amino-acids are not present, or exist in very small amounts (See 4) in the non-protein nitrogen solution. This conclusion is confirmed also by the formaldehyde titration.

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[*] Journ. Biol. Chem. 7, 1910, p. xxxiv.

[†] Amer. chem. Journ. 29, 1903, 168.

This slow decomposition, with formation of ammonia, is characteristic of certain groups of organic compounds. Erdmann † has shown that compounds containing the nitril grouping, when heated with sulphuric acid; form amines, and finally ammonia.

Embden‡ found that cystin gives off ammonia, when boiled for a long time with magnesia; and Mathews and Walker§ that it oxidised spontaneously in alkaline solutions, setting free ammonia. Neuberg and Mayer|| crystallised cystin in radiating bunches of needles like tyrosin.

Jolles¶ by slow oxidation of plant-protein, at ordinary temperature, obtained urea 50%, nitrogen in phosphotungstic acid precipitate 20%, and in filtrate 30% of the total nitrogen. The urea originates in the—CO·NH—and—CO·NH_2 groups of the protein molecule, and is analogous with the breaking down and oxidation of proteins in the organism.

Plimmer**, by oxidising albumins, obtained hydrocyanic acid, and he states that it arises from the glycin and aspartic

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* Zeit. physiol. Chem 30, 1900, 556.

† ERDMANN—Journ. Biol. Chem. 8, 1910, 41.

‡ EMBDEN—Zeit. physiol. Chem. 32, 1900, 95.

§ MATHEWS & WALKER—Journ. Biol. Chem. 6, 1909, 289

|| NEUBERG & MAYER—Zeit. physiol. Chem. 44, 1905, 472.

¶ JOLLES—*ibid.* 32, 1900, 361.

** PLIMMER—Journ. Physiol. 32, 1904, 51.

acid. Maly* and others also obtained oxidation-products of proteins, which were not precipitated by tannic or phosphotungstic acids, gave no Millon or xanthoproteic test, but a positive biuret. These products, heated with alkali, evolved large amounts of ammonia; after hydrolyses, they yielded amino-acids and ammonia, and gave off nitrogen when acted on by nitrous acid.

Plants and seeds contain protease and oxidase ferments, and, therefore, it is not improbable that the above oxidation-products are present in the non-protein solution.

Polypeptides.—Swirlowski† submitted protein to hydrolysis with 0·5% hydrochloric acid, at 37° C for six months. The phosphotungstic filtrate then contained 27% of the nitrogen, and no amino-acids could be obtained, until hydrolysed by strong acids. These polypeptides gave only the biuret reaction.

We have now seen that both tannic and phosphotungstic acids may not precipitate the smaller polypeptides. If we assume the presence of these in the Acacia solutions, then (1) we know, from the negative Millon test, that the tyrosin nucleus is not a constituent. (2) It is more difficult to explain the absence of the biuret reaction; though it is just possible that the biuret-yielding group is absent, it is more likely that, with these particular polypeptides, the reaction is not reliable. (3) By ordinary hydrolysis, only small amounts of ammonia would be set free, certainly not sufficient to account for the large amount obtained. On the other hand, if oxidation has also taken place, then, as has already been shown, oxidation-products could be slowly formed, which would provide large amounts of ammonia on distillation. (4) By the severing of imino-linkings in the polypeptide hydrolysis, amino-groups would certainly appear, which ought to be detected by the nitrous acid method. The latter, however, gives no nitrogen after the phosphotungstic precipitation and hydrolysis, and this result may be interpreted, either as proof of the absence of polypeptides, or that, by steric hindrance, the reaction is made exceedingly slow.

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* Maly—Sitzber. Wien. Akad. 1889; Monatshr. 1889.

† Zeit. physiol. Chem. 48, 1906, 252.

THE RÔLE OF NITROGEN IN PLANT-METABOLISM.

Part iv.—The Nitrogen of Ripening Seeds.

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The investigations of Emmerling, Wassilieff, and Schulze have led to the assumption that, during the ripening of seeds, organic nitrogen compounds are transferred from other parts of the plant, principally the green leaves, to the seeds. As the protein-content of the seeds rapidly increases during the progress of ripening, it is, therefore, assumed that, in the process, the synthesis of proteins has taken place, that the protein is formed where the carbon-assimilation is most active, and that it does not accumulate there, but is transferred to the growing parts of the plant.

It is obvious, since the proteins occurring in the sap of plants possess entirely different properties, both physical and chemical, from the proteins which are stored as reserve-food in the seeds, that a change must take place in the constitution of the former. Now we can conceive of this change only as one of cleavage along the same path as in artificial hydrolyses, and having as end-products the amino-acids. But there are also formed numerous intermediate products, the polypeptides, diminishing in complexity, from the very slightly altered metaprotein downwards, and including the albumoses and peptones. Then ammonia is always set free as the result of the cleavage of protein.

There is invariably formed in the leaves of plants, by a secondary action, a group of substances not found in artificial hydrolysis, viz.—the amides, glutamin and asparagin. They are formed from ammonia and carbohydrates, and hence the ammonia never accumulates in the plant under normal conditions. This cleavage of protein is the work of the protease ferments, which have been shown to have a wide distribution in plants.

The soluble cleavage-products are carried to the growing seed, where the protein is regenerated, probably by the reverse action of ferments, since both protease and erepsin have been found in unripe seeds[*]; and it has been shown that the same ferments are able both to hydrolyse and synthesise proteins under suitable conditions.[†] Emmerling[‡] and others were led, by their results, to the view that the amides were the principal material for the synthesis.

Now the only amides yet discovered in plants are those of aspartic acid and glutaminic acid, and these are only two out of about twenty known hydrolytic products of plant-proteins. It is, therefore, incomprehensible how the entire molecule of the protein can be synthesised chemically from amides. We must rather look for an interpretation based on our present knowledge of the protein-chemistry; and, first, when we consider the manner in which the hydrolysis of proteins is brought about by enzymes *in vitro*, we find a large proportion of those first cleavage-products, meta-proteins, albumoses, peptones, and the larger polypeptides, with only small amounts of amino-acids. Then we should expect to find these substances in the translocating material of the living plant.

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[*] Zaleski—Ber. Bot. Ges. 23.

[†] Taylor—Journ. Biol. Chem. 3, 1907, p.87.
Brailsford Robertson—*ibid.* p.95.

[‡] Landw. Versuchs-Stat. B.34, 1; B.54, 215.

Albumoses and peptones were identified in plants by Schulze[*] and Neumeister[†] in 1894, and in the unripe seeds by Frankfurt[‡], Nedokutschajeff[§], and Zaleski[¶].

It seems most probable, then, that the highly complex globulins and albumins of the seed-reserves are formed, in great part, from these proximate cleavage-products which are still to be recognised as simpler proteins.

There is no doubt, however, that amino-acids also exist in the ripening seeds, for Wassilieff[**] has identified, in unripe seeds of *Lupinus*, arginin, histidin, phenylalanin, valin; and Schulze[††] found, in addition to the above, tyrosin and lysin in unripe seeds of *Pisum sativum*, but these amino-acids were found only in very small amounts. It is most probable that they are the result of very slow hydrolysis of the proteins in the seeds, by the ferments present.

Accompanying those essential cleavage-products in the plant-sap, there occur the cleavage-products of other substances set free in the metabolism, such as cholin, betain, trigonellin, vernin, allantoin, purins, nucleins, etc. These are also conveyed to the ripening seed, and are deposited there, with the protein. They are estimated in the analyses with the nonprotein-nitrogen compounds; and, as far as we know, are unsuitable material for the protein-synthesis.

As the seeds ripen and the total nitrogen-content increases, there occurs a relative change in the distribution of the nitrogen, as designated by the terms protein- and nonprotein-nitrogen respectively.

In order to interpret this change, the following are selected from a series of experiments carried out at the beginning of 1909, on the ripening of seeds.

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[*] Journ. prak. Chem. B. 27, 358; 32, 449.

[†] Zeit. f. Biol. B. xii.

[‡] Landw. Versuchs. B.47, 452.

[§] Versuchs-Stat. 1902, 1903.

[¶] Ber. d. Bot. Ges. 23.

[**] Journ. exp. Landwirtschaft. (russ.) 1904, S.34.

[††] Zeit. physiol. Chem. 65, 1910, S.431.

A.—Experiments with *Vicia sativa.*

The pods of the Wild Tare, *Vicia sativa,* growing in the open fields, were collected in March, and in widely different stages of their development.

Stage 1.—Very immature seeds, small, soft and green; 100 of these seeds in the fresh, moist state, with skins, weighed 0·9 gm.

Stage 2.—Older seeds, larger, soft and green; 100 of these weighed 3·1 gms.

Stage 3.—Very ripe seeds, dry, hard and black; 100 of these seeds weighed 1·7 gms.

Method of experiment.—The material collected was immediately brought into the laboratory, and the seeds separated from the pods. The weight of one hundred moist seeds was found; and amounts of the entire seeds, with skins left on and in their original fresh moist condition, were weighed out for the experiment, within ten minutes of their separation from the plants in the field. About 0·5 gm. was taken for the estimation of the total nitrogen, by Kjeldahl's method; the seeds were dropped into a flask, with H_2SO_4, and heated, with addition of potassium bisulphate, and with copper sulphate as an accelerator. The heating was continued for six hours, and the ammonia distilled in the usual way.

A weighed quantity was next crushed in a mortar, and quickly transferred to a flask, with about 500 cc. of distilled water; heated on a water-bath at 80° C., for two hours; and the fluid decanted through muslin. After adding another half litre of water to the flask, the extraction was continued for one hour; after which, the fluid was poured off, and the operation repeated twice, in all four extractions. The residue of insoluble material in the flask, was then pressed in the filter-cloth, and discarded. The combined fluids were then measured, and filtered clear through filter-paper, and a definite amount evaporated, on the water-bath, to a small volume; this was poured into alcohol, making the liquid up to a strength of 85% spirit. After heating to 70°, then allowing to stand till cold, the precipitated proteins were filtered off. From an aliquot portion of the filtrate, the alcohol was distilled off, and the nitrogen of the residue estimated by Kjeldahl's process. This is designated the non-protein nitrogen.

It is not assumed that this separation of proteins is complete, indeed it is almost certain that the simpler polypeptides remain unprecipitated, and are included in the nonprotein nitrogen solution. The complete separation of proteins from such mixtures, is a matter of very great difficulty.

The results of the determinations are here tabulated:—

TABLE i.

100 gms. of fresh seeds of *Vicia sativa* contain:—

Stage	Protein-N.	Nonprot.-N.	Total N.
1	1·088 gms.	0·702 gm.	1·790 gms.
2	1·129	0·541	1·670
3	4·345	1·085	5·430

The results here show that, in 100 gms. of the very young seeds, containing 1·79 gms. of total nitrogen, the protein-nitrogen is 1·088 gms., and the nonprotein-nitrogen 0·702 gm. In the second stage of their development, the protein-nitrogen has increased to 1·129 gms.: the nonprotein-nitrogen is 0·541 gm.; and the total nitrogen is slightly less than in Stage 1. In the perfectly ripe seeds, the total nitrogen has increased to 5·43 gms., and consists of 4·345 gms. of protein- and 1·085 gms. of nonprotein-nitrogen.

By comparing the same number of seeds in each case, the absolute amount of nitrogen, in the two different forms, becomes at once apparent. Table ii. shows the contents of 100 seeds in the same three stages of development.

TABLE ii.

100 seeds of *Vicia sativa* contain:—

Stage	Weight	Protein-N.	Nonprot.-N.	Total N.
1	0·9 gms.	0·010 gm.	0·006 gm.	0·016 gm.
2	3·1	0·036	0·017	0·053
3	1·7	0·076	0·019	0·095

During the ripening of the seeds, the total nitrogen has increased about six times. In the first stage, the seeds contain 10 mgs. of protein-nitrogen. In the second stage, there have been added, from external sources, 26 mgs. and 11 mgs., respectively; and, in the final stage of development, the perfectly ripe seeds have received a further increment of 40 mgs. and 2 mgs. of each, respectively.

In Table iii., are given the relative amounts of the protein- and nonprotein-nitrogen in per cent. of the total nitrogen, where it is seen that the protein-ratio increases, while the nonprotein simultaneously diminishes, throughout the same stages of development.

TABLE iii.

Table ii. expressed in per cent. of total N :—

Stage	Protein-N.	Nonprot.-N.
1	62·5 %	37·5 %
2	68·0	32·0
3	80·0	20·0

Conclusions.—From these results we may draw the conclusion that, with the entrance of nitrogenous substances into the seeds, there is a simultaneous increase in the amounts of both protein and nonprotein nitrogen-compounds, the mature seeds containing the largest amount of each. There is, thus, no evidence that nonprotein-nitrogen has been transformed into protein-nitrogen, but rather that the nonprotein-nitrogen, at least in part, is represented by a residue of unsuitable material left in each case*. If the latter consisted of plastic material available for the protein-synthesis, we should expect it, in the perfectly ripe seed, to be almost entirely consumed. On the contrary, in all ripe seeds that have hitherto been examined, there still remains a considerable residue of nonprotein-nitrogen, and this condition remains practically unaltered throughout the dormant state.

In a previous paper (Part ii.)† a number of such determinations are given, showing the amounts of protein- and nonprotein-nitrogen in various seeds.

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* *Antea* p.129

† PETRIE—These Proceedings, 1908, xxxiii., p.342.

As to the function of the pods in the Leguminosæ, there is some evidence that they act as stores for reserve-material. Schulze and Winterstein* have shown that, during the ripening of *Pisum sativum*, protein-decomposition takes place in the pods, and the soluble material is transported to the seeds, as the latter ripen, till, in the end, only 30% of the original protein- and 8% of the original nonprotein-nitrogen are left.

Not only does this transference take place while the pods are growing on the plant, but also after their removal from the stem they continue to supply material for the formation of protein to the enclosed seeds. The results of an experiment to prove this point are given below.

B. Experiments with *Vicia faba.*

Broad beans, *Vicia faba*, were grown in an experimental plot. The pods were collected at about the middle period of their growth, and examined, with the object of determining whether any change in the distribution of the nitrogen in their seeds took place, when these were left for a definite time, enclosed in the isolated pods.

Three stages were arranged as follows:—

Stage 1. Beans collected, and immediately examined for protein- and nonprotein-nitrogen: 100 beans weighed 22·6 gms.

Stage 2. Beans left two days in the pods, then examined: 100 beans weighed 65·7 gms.

Stage 3. Beans left five days in the pods, then examined: 100 beans weighed 63·5 gms.

The unopened pods were left in a moist atmosphere, under a bell-jar, for a given time; the seeds were then removed from the pods, and, with their skins on and in the moist condition, the weight of one hundred was ascertained. The methods of extraction and nitrogen-estimation were the same as those given in A.

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* Zeit. Physiol. Chem. 65, 1910, s.431.

The following are the tabulated results of the experiment:

TABLE iv.

100 gms. of fresh *Vicia faba* seeds contain :—

Stage.	Protein-N.	Nonprot.-N.	Total N.
1	0·950 gm.	0·340 gm.	1·290
2	1·124	0·186	1·310
3	1·476	0·174	1·650

The seeds, when examined at once, contained 1·29% of nitrogen, composed of 0·95 in form of protein- and 0·34 in form of nonprotein-compounds. After two days, Stage 2, the total nitrogen was 1·31%, distributed in the form of protein 1·124, and other forms 0·186. In Stage 3, after 5 days in the isolated pods, the total nitrogen had increased to 1·65%, and included 1·476 of protein- and 0·174 of nonprotein-nitrogen, respectively.

The amounts, calculated for 100 seeds, are given below.

TABLE v.

100 seeds of *Vicia faba* contain :—

Stage.	Weight.	Protein-N.	Nonprot.-N.	Total N.
1	22·6 gms.	0·172 gm.	0·080 gm.	0·252 gm.
2	65·7	0·846	0·120	0·966
3	63·5	0·960	0·090	1·050

TABLE vi.

TABLE v. expressed in per cent. of total nitrogen :—

Stage.	Protein-N.	Nonprot.-N.
1	58·0	32·0
2	87·5	12·5
3	91·4	8·6

From Table v., we ascertain that the seeds, by lying in the isolated pods for five days, gain in total nitrogen, and the absolute amount of protein has increased. Since, between the first and third stages, the nonprotein-nitrogen has but slightly increased, it seems that the protein in the seeds could only have been augmented by the addition of protein or protein-derivatives, which are precipitated by alcohol. The only source possible for this additional protein, then, lies in the pods, which, therefore, appear to act as reserve-holders for the nitrogenous supply to the seeds, under special conditions.

THE RÔLE OF NITROGEN IN PLANT-METABOLISM.

Part V.—The Occurrence of Potassium Nitrate in Plants.

By J. M. Petrie, D.Sc., F.I.C., Linnean Macleay Fellow of the Society in Biochemistry.

(From the Physiological Laboratory of the University of Sydney.)

Potassium nitrate is one of the principal forms in which plants receive their nitrogen from the soil. Although this salt has been detected in small quantities in very many plants, it accumulates and is stored, as a reserve, in only a few. It is, therefore, of interest to record the occurrence of a comparatively large amount of this salt in the evergreen shrub, *Solandra grandiflora*, N.O. Solanaceæ.

This plant was collected at Grafton, N.S.W., by Dr. H. G. Chapman, in May of 1909, when the autumn leaves were beginning to fall; and for the special purpose of investigating the alkaloid contained in it.

Experimental.—Leaves weighing 20 kilogms., were air-dried, disintegrated, and extracted with hot water acidulated with tartaric acid. This water-extract was evaporated to a thin syrup, treated with alcohol, and filtered. From the clear solution, the spirit was removed by distillation under diminished pressure; the residue left in the still was dissolved in water, filtered clear, and the solution concentrated on the water-bath. There now separated, on cooling the solution, 130 gms. of crystals which, on dissolving in water and recrystallising, formed two layers. The surface-layer consisted of lath-shaped crystals of potassium nitrate, about 1 inch long; and the second, a considerable quantity of small cubical crystals of potassium chloride. These potassium salts were obtained as a by-product only; and the superfluid possessed the odour of strong tobacco, but only a very small amount of alkaloid was obtained from it.

Result.—In the solution of crystals, the nitrate was determined by the nitrometer, and gave 58 gms. of potassium nitrate. The volume of the combined mother-liquors, from which the crystals had been obtained, was 1300 cc., and, taking this as a saturated solution, it contained 292 gms. The total amount is, therefore, 350 gms. potassium nitrate, equivalent to 2·01% of the plant dried at 110° C. A sample of the plant dried at 110°, contained 16% of inorganic matter.

The experiments of Andre* show that the amount of nitrate in plants generally varies with the period of life. It increases to a maximum with the formation of flower-buds, and rapidly diminishes again to a small amount. From this we see that the *Solandra* leaves were collected at a time when their nitrate-content would be a minimum.

Historical.—As long ago as 1747, Stahl† noticed the existence of nitre in the tobacco plant: and Braconnot‡, in 1827, records the abundance of this salt in certain plants; its wide distribution in the phanerogams was also shown by De Candolle§. In the following plants, nitrates occur as reserve-material stored in exceptionally large amounts, which are expressed as potassium nitrate % of the whole plant or part, dried at 100° C.

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* C.R. 142, 1900, 106.

† STAHL.—Fundamenta Chymiæ, 1747, p.106.

‡ BRACONNOT.—Annal. chim. physiq. (2), 36, 1827, p.260.

§ DE CANDOLLE.—Physiologie, i., 383.

NITRATE PLANTS.

	Potassium nitrate,
Nicotianum tabaccum*	large amounts.
Helianthus annuus	large amounts.
Ricinus communis	large amounts.
Amaranthus atropurpureus†	large amounts.
Amaranthus ruber†	large amounts.
Portulaca oleracea‡	stems, 12·4 %.
Beta vulgaris§	stems, 8·4.
Amaranthus pyramidalis‡	plant, 6·4.
Enchylæna (Chenopod)‡	leaves, 6·2.
Borago officinalis‡	plant, 4·2.
Papaver rheas‡	stems, 3·1.
Triticum sativum¶	stems, 2·8.
Solanum tuberosum¶	stems, 1·5.
Urtica dioica¶	stems, 1·3.
Avena sativa¶	stems, 0·9.

Nitrates in Metabolism.—By cultivation and aëration of the soil, nitrification is greatly increased, with the result that nitrates are most available for absorption by plants. On the other hand, the soil of moors and forests is found to contain hardly any nitrate; and Baumann, in testing unworked soils, found only minute traces, too small to estimate. This is probably a reason for the small amounts found by Berthelot and André*:—In Moss, 0·005% in dry material; *Equisetum*, 0·036%; *Pteris aquilina*, 0·30%; *Pinus sylvestris*, 0·020%.

In their numerous experiments, these authors found that nitrate occurred in only small amounts in the roots, reached a maximum in the stems, and rapidly decreased to the leaves, where it is apparently utilised in the synthesis of organic compounds. Leaves and flowers contained least, and the seeds none. These experiments also showed that plants grown in nitrate-free soil gained nitrate; and led the authors to state that nitrification takes place in the plant-cells, and especially in the stems—at least in those plants that are rich in nitrate; and that this process is similar to that of nitrification in the soil, and is due to the same general function of cells which gives rise to the oxidised acids, oxalic, malic, and tartaric.[*] These views were also held by Kreusler[†], Belzung[‡], and others; and to understand them, it is necessary to recollect that their experiments belong to the period immediately preceding Winogradsky's classic work.

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* Stahl.—Fundumenta Chymiæ, 174, p.105.

† Boutin.—C.R., 78, 1874, p.281.

‡ Berthelot et André.—Annal. chim. physiq.(6), 8, 1886, 28.

§ Pellet.—Bied. Cent., 1880, s.235.

¶ Berthelot.—C.R., 98. 1884, 1606.

† Boutin's figures (22·7%, 16%) are copied into the standard text-books. They are really the water-soluble ash taken as wholly potassium carbonate, and calculated into potassium nitrate.

* Landw. Versuchs-Stat. 33, 1887, 247.

However, their results have not been conclusively confirmed since, and they are entirely opposed to those of Molisch and Frank[§] and Schulze[¶], who hold that all the nitrate in plants has been absorbed entirely through the roots.

For the higher plants, potassium nitrate has been shown to be the more suitable nitrogen source, although some grow just as well with ammonium salts. Pitsch[**], however, has shown that the presence of nitrate in the plant enables it to take up more nitrogen in other forms, such as ammonia; and in every case, except wheat, nitrate-plants utilised much more of the other forms of nitrogen than the ammonia-plants did. Ammonia does not accumulate in the plant, but, when deprived of light, acid-amides are formed, from which the ammonia is readily recovered when required. On the other hand, nitrates can be stored in the tissues as reserve-material.

Demoussy[††] has shown that the living protoplasm possesses the power of firm retention of nitrates; so that, although exceedingly soluble outside, the nitrates cannot be extracted from the plant-cells by cold water. When, however, the plant is killed by boiling water, ether, etc., cold water removes the salts. Similarly dead leaves and roots are quickly deprived of their nitrates by rain.

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[*] Berthelot et Andre.—*Loc. cit.*, pp. 126, 128.

[†] Landw. Jahrb., 1886, 309.

[‡] Journ. de Bot., 1893, 37.

[§] Ber. bot. Ges., *5*, 1887, 472.

[¶] Zeit. physiol. Chem. 22, 1896, 82.

[**] Landw. Versuchs-Stat., 42, 1892.

[††] C.R. 118, 1894, 79; 127, 1898, 771.

Nedokutschaeff*, by growing various seedlings in Knop's nutritive solution showed that when he increased the concentration of nitrate, more accumulated in the plant; and when a certain amount was stored, no more was taken up. This limit varied with different plants, and varied with the kind of base, being greatest when combined with potassium.

Towards the elucidation of the manner in which the nitrogen-group enters the carbon-chain, the discovery of Abelous and Aloy† is important. An enzyme has been isolated from green plants, capable of reducing nitrates to nitrites and ammonia, even evolving gaseous nitrogen‡.

It was shown, also, that the reduction takes place only in the presence of carbohydrates. This co-relation between nitrates and sugars is again brought out in the experiments of Pellet§. A long beetroot was sliced and analysed. It contained much sugar at the tip, the amount rapidly diminishing towards the crown; and, conversely, the potassium nitrates was small at the tip, and increased upwards.

De Plata's¶ experiments show that a large production of sugar in plants is associated with abundance of potassium; and Krüger** found that, whereas many plants feel the lack of potassium very quickly, those which contain the large reserves of potassium nitrate, such as the beet, continue to flourish normally till these reserves are consumed.

After Zaleski†† and Suzuki‡‡, there seems no doubt that, in green plants, nitrates can contribute to the formation of protein, without light, provided only that carbohydrates be supplied: and that this change always begins by a reduction of the nitrates, through nitrites to ammonia. Now one of the easiest methods of lengthening the carbon-chain (*in vitro*) is through the formation of nitrils by hydrocyanic acid; and Treub* believes that, in the presence of glucose, nitrates are directly transformed into nitrils as the first assimilation-product. This sudden step is difficult to comprehend from the chemical point of view; it is, however, supported by the recent experiments of Ravenna and Peli†, where the production of hydrocyanic acid in *Sorghum vulgare* was traced to the simultaneous action of nitrates and carbohydrates, favoured by light. These authors state that hydrocyanic acid appears to be the simplest substance which can be detected as taking part in the synthesis of protein.

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* Ber. bot. Ges., 21, 1903, 421.

† C.R., 55, 1903, 1080.

‡ IRVING and HANKINSON.—Biochem. Journ., 3, 1908, 87.

§ Bied. Cent., 1880, 235. Abst.-J.C.S.

¶ Chem. Cent., 1910, 1623.

** Z. Ver. Zuckerind., 58, 1908, 739.

†† Bot. Cent., 87.

‡‡ Bul. Coll. Agric. Tokyo, 2 and 3.

Instead of the above sudden transformation of the nitrate, it seems more probable that the enzymic reduction of nitrate to ammonia is the natural one. It is then easy to follow the subsequent stages along certain possible directions well known in organic chemistry, and which can easily be demonstrated. (1) The formation of ammonia as stated above. (2) The production of hydrocyanic acid from formaldehyde through formic acid, ammonium formate, and formamide; and, in the same way, we have the passage of aldehydes in general through their acid-amides to nitrils, which is the view held by Laurent and Marchal. (3) From the interaction of ammonia, hydrocyanic acid or the nitrils, and the various aldehydes can be produced all the known amino-acids, and hence the synthesis of proteins.

I wish, in conclusion, to express my indebtedness to Professor Anderson Stuart for affording every convenience in the laboratory to the carrying out of this work.

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* Annal. Jard. Bot. Buit. 1895.

† Gazzetti, 37, 1907, 586.

THE *AMYCTERIDÆ* OF THE "*VOYAGE DE L'ASTROLABE*," 1835.

By Eustace W. Ferguson, M.B., Ch.M.

In 1835, there appeared, in the "Voyage de l''Astrolabe'" (Vol. ii.), the descriptions, by Boisduval, of several new Australian weevils referred to the genera *Amycterus* and *Acantholophus*. In this work, Boisduval appears not only to have described the specimens actually brought back by the 'Astrolabe,' but to have listed previously described species; and, all too briefly, to have diagnosed, and named those which were in other Parisian collections.

Through the kindness of the authorities of the Brussels Museum, and of Mr. A. M. Lea, of Tasmania, I have recently had the opportunity of examining such types as belonged to the Coll. Dejean. As the descriptions of these are all quite inadequate and worthless, being composed mostly of a couple of lines in Latin, with a French translation beneath; and as the species are mainly unknown or misidentified here in Australia, I have endeavoured to redescribe them more clearly, and to relegate them to their proper genera.

Following is a list of the species described or mentioned, with the name of the Collection from which the specimen was described.

Species.	*Genus in Masters' Catalogue.*	*Collection.*
Psalidura mirabilis Kirby	*Psalidura*	Dejean
* „ *reticulata* (Macl.) Boisd.	„	„
* „ *crenata* (d'Urv.) Boisd.	„	„
„ *impressa* Boisd.	„	—
„ *mirabunda* Gyll.	„	—
* *Talaurinus scaber* Boisd.	„	Dejean
* „ *tuberculatus* (d'Urv.) Boisd.	„	„

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* Indicates species of which type has been examined.

*	*Talaurinus verrucosus* Boisd.	*Talaurinus*	—
	,, *tomentosus* Boisd.	,,	—
	,, *rugifer* Boisd.	,,	Dupont
*	,, *morbillosus* (d'Urv.) Boisd.	,,	Dejean
*	,, *costatus* (d'Urv.) Boisd.	,,	,,
	,, *bucephalus* Oliv.	,,	,,
*	*Sclerorhinus carinatus* (d' Urv.) Boisd.	*Psalidura*	,,
*	,, *morosus* (d'Urv.) Boisd.	*Cubicorrhynchus*	,,
	,, *bubalus* Oliv.	*Sclerorhinus*	Dejean Dupont
	,, *tristis* Boisd.	,,	Dupont
	,, *dolens* Boisd.	,,	—
	,, *Kirbyi* Guér	—	Mus. Nat.
	Acantholophus Marshami Kirby	*Acantholophus*	Dejean Dupont
	,, *echinatus* Boisd.	,,	Mus. Nat. Dejean
	Amycterus Boisduvali (Dup.) Boisd.	*Amycterus*	Dupont
	Euomus scorpio Boisd.	*Euomus*	—
	,, *Stephensi* (Hope) Gyll.	,,	—
	Mythites basalis (Dejean) Boisd.	,,	Dejean Dupont
	Genus ? *posticus* Boisd.	*Psalidura*	Dupont
	,, *granosus* Guér	,,	Mus. Nat.

Notes on the above list, with synonymy.

The species of *Psalidura* having been recently fully commented on, I shall pass them over.

T. scaber Boisd., = *T. aberrans* Macl.—I have compared the types of these species, and can find no difference.

T. verrucosus Boisd., = *T. tuberculatus* Boisd.—These names apply to the species previously described as *T. verrucosus* Guérin.

T. tomentosus Boisd.—A species close to, if not belonging to, *Psalidura*; easily identified from the description and figure.

T. rugifer Boisd.—I have not seen the type of this species, but Boisduval has given a fairly lengthy description. *T. excavatus* Bohem., may prove synonymous.

*** Indicates species of which type has been examined.**

T. morbillosus Boisd.—Macleay was mistaken in his identification of this insect, the one redescribed by him having no affinity to the true *T. morbillosus* Boisd.

T. costatus Boisd.—Previously described by W. S. Macleay as *P. Kirbyi*. The species must, therefore, bear the name of *Talaurinus Kirbyi* W. S. Macleay. *T. Mastersi* Macl., is also synonymous.

T. bucephalus Oliv.—A common New South Wales species, with somewhat extensive synonymy.

Scl. carinatus Boisd.—Probably synonymous with *Hipporrhinus nigro-spinosus* Donov., to judge from the figure in Donovan's Epitom. Ins. N. Holl. 1805.

Scl. bubalus Oliv., = *Scl. morosus* Boisd.—The identity of these two species is evident from a comparison of Olivier's figure with Boisduval's type. The name *morosus* Boisd., has long been in use for a species of *Cubicorrhynchus*, not only among Australian entomologists, but by Bohemann, Germar, Pascoe and others. *Scl. bubalus* has priority.

Scl. tristis Boisd.—A common Tasmanian and Australian species, with extensive synonymy.

Scl. dolens Boisd.—Unknown to me.

Ac. echinatus Boisd.—The type, while agreeing with the description of *Ac. echinatus* Guér., differs in the dimensions. Guérin's species was described from Port Jackson, where a species commonly identified as *Ac. echinatus* Guér., but differing from *Ac. echinatus* Boisd., is found. Pending investigation of Guérin's species, I have not described Boisduval's type, particularly as *Ac. mucronatus* Macl., is founded on the same species.

Amycterus Boisduvali Boisd.—I have not seen the type of this species, nor of those of the "Euomides" described by Boisduval, but they are all well known species. Of the two species, —*granosus* Guér., and —*posticus* Boisd., which are unknown to me, the former is probably a species of *Talaurinus*, and perhaps *T. bucephalus* Oliv.; it is from Port Jackson; *posticus* is placed in Masters' Catalogue in *Psalidura*, but from description it should not belong to that genus, and I am quite unable to place it.

All the types examined bore six labels which I have numbered correspondingly—

(1) Locality-label, except when quoted, Nouv. Hollande.

(2) Collection-label: Coll. Dejean; Coll. Roelofs—both names on one label.

(3) Name of species, with entomologist's name, *e.g*,, morbillosus d'Urville.

(4) Type.

(5) Principal label, quoted in full, written on pale, faded pink paper.

(6) *E.g.* type, *T. morbillosus.*

TALAURINUS MORBILLOSUS Boisd., *l.c.* p.386.

♂. Briefly oblong, subparallel, convex. Prothorax granulate, elytra seriate-granulate. Black, opaque; nigro-setose.

Head convex, forehead feebly concave between the ends of the external rostral ridges, a faint longitudinal impression present in front; sparingly, almost obsoletely, setigero-punctate. Rostrum short, thick, as broad at apex as head; external ridges subparallel, separated from head by a slight constriction; internal ridges extending almost to apex, convergent basally, but separated by median notch; lateral basal impressions long, rather deep posteriorly, together with transverse basal sulcus forming a horseshoe-shaped impression; intermediate area depressed, almost linear, leading into depression behind marginal plate. Scrobes deep, not continued back to eye. Eyes moderately large, ovate. Antennæ long, first joint of funicle longer than second, third to sixth subequal, club elongate. Prothorax (5 × 5·5 mm.) subrotundate, apex slightly produced, ocular lobes feeble, base truncate, no median linear impression; finely and densely granulate, granules rounded, rather towards sides, each with a minute seta; sides granulate, obsoletely so near coxæ. Elytra (10 × 7 mm.) gently rounded on sides, almost subparallel; apex widely rounded, feebly flanged, and slightly mucronate; base arcuate, humeral angles marked with a tuberculiform granule. Disc convex, shallowly striate, striæ irregular, crossed by transverse rugæ, but not definitely foveate; interstices with small, round, feebly flattened granules in single series, on sutural interstice finer and more numerous, becoming larger towards base; second and fourth each with from five to eight granules; third and fifth with from twelve to fourteen rather smaller, more closely placed, granules; on all the interstices the granules become more distantly spaced on the declivity. Sides irregularly, somewhat rugosely, granulate. Metasternum flat. Third and fourth ventral segments short, together less than fifth; fifth shallowly excavate with a deep, subquadrate, median fossa, having a small distinct tubercle on either side, posterior edge straight. Obtuse ends of forceps appearing at sides. Legs long; tibiæ with stout setæ or spines on undersurface; posterior tarsi elongate. *Dimensions*: ♂ 15 × 7 mm.

Hab.—New South Wales: Port Jackson (Boisduval); Queanbeyan (A. M. Lea).

Labels: 1, 2, 3, 4, 5, Phalidura [struck out] morbillosa d'Urville, h. in Nova Hollandia, D. d'Urville; 6,—

The elytral granules vary somewhat in number on the two sides of the elytra, and in different specimens. Most closely allied to *T. M-elevatus* Lea, but abundantly distinct in having all the elytral interstices granulate. There is some doubt as to whether these two and allied species would not be better included in *Psalidura;* both have the intermediate ventral segments short, the ends of the forceps projecting externally; and in *T. M-elevatus*, dissection shews the presence of a median vertical plate.

The name *T. morbillosus* Boisd., has been used by Macleay for a very different insect, from Victoria.

T. orthodoxus Lea, is also closely related, but differs in the elytral granules being subconfluent, slightly in the rostrum, and in the position of the tubercules on the fifth abdominal segment.

TALAURINUS SCABER Boisd., *l.c.* p.382.

T. aberrans Macl., Trans. Ent. Soc. N. S. Wales, I., 1865, p.233.

♂ Small, oblong, somewhat flattened above. Black; thickly clothed above with dense grey and ochraceous scales; below with a light median vitta of greyish scales; setæ long, light coloured.

Head convex, continued into rostrum in the same direction as internal ridges. Rostrum short, nearly as wide at apex as head, space between external ridges narrow; external ridges parallel, not continued on to forehead, convex in profile; internal long, oblique, more prominent at base than external; basal sulci long, each ending posteriorly in a deep fossa, median area canaliculate. Head and rostrum both densely clothed. Scrobe consisting of a main deep anterior portion and a short shallow fossa open posteriorly. Eyes moderately large, oval. Antennæ long, first funicular joint nearly twice the length of second; club briefly pedunculated. Prothorax (3·5 × 4 mm.) markedly angulate on sides, widest anteriorly to middle; postocular sinuosity strong, giving rise to a definite short median lobe. Disc feebly convex, with a faint irregular collar, and median impressions; finely and irregularly granulate, granules fewer and sparser on sides. Elytra (8 × 5 mm.) gradually widened from base to behind apex, then abruptly contracted, and the apex obtusely rounded and feebly mucronate; base arcuate, humeral angles tuberculiform. Disc with small tubercles longitudinally and transversely arranged; sutural row with small granules obscured by clothing; second with eight tubercles not reaching to base, the fifth tubercle on the edge of the declivity, very prominent, followed by three small ones on the declivity; third with four or five tubercles, the basal one constituted of three smaller ones, none present on declivity; fourth with four tubercles not extending to base; fifth or humeral consisting of eight closely placed tubercles diminishing in size from the large humeral one, also three small ones more posteriorly; sixth with six tubercles not reaching to base, becoming more prominent posteriorly and ending abruptly just below the level of the fifth tubercle of the second row; seventh obsolete. Sides seriate-punctate, interstices obsoletely granulate. Intermediate ventral segments together longer than apical; fifth segment with a transverse impression at apex. Legs moderately long, tibiæ setigerous and spinose; tarsi linear. Dimensions: ♂ 13 × 5 mm.

Hab.—New Holland (Boisduval)—Victoria (Macleay Museum—New South Wales: Grenfell (E. W. Ferguson).

Labels: 1, 2, 3, 4, 5, Phalidura [struck out] scabra d'Urville, h. in Nova Hollandia, D. Lesson; 6, Type *P. scabra*.

TALAURINUS KIRBYI W. S. Macleay.

W. S. Macleay, King's Survey ii., 1827, p.444; W. Macl., *l.c.*, p.238; *T. costatus* Boisd., *l.c.* p.384; *T. Mastersi* Macl., *l.c.* p.239.

Type, *T. costatus* Boisd., ♀—Elongate-elliptical, convex. Black, clothing confined to a few muddy scales in the depressions; setæ minute.

Head not sharply marked off from rostrum, forehead concave between rostral ridges. Rostrum narrower than head, external ridges prominent, slightly convergent posteriorly, straight in profile, continued on to head above eyes; internal ridges long, oblique; basal sulci long, deep, running into excavation of forehead; median area strongly depressed. Scrobes open behind, secondary fossa present posteriorly. Eyes small, subrotundate. Prothorax (4·5 × 5·5 mm.) evenly rounded on sides, postocular sinuosity slight; granules small, closely set, somewhat flattened; granules obsolete on sides near coxæ. Elytra (13 × 8 mm.) ovate, apex feebly mucronate; base slightly emarginate, shoulders obtusely prominent. Each elytron with two broad double striæ and two single lateral ones on disc; the double striæ feebly transversely rugate, each with two rows of fine punctures between the rugæ, each puncture with a seta on the ridge above it; lateral striæ each with a single row of punctures; sutural interstice costate, well defined; second very prominent, costate; third humeral subcostate, less prominent; fourth and fifth lateral, close together, almost obsoletely granulate. Sides with interstices obsoletely granulate. Beneath convex; intermediate ventral segments large, fifth with a small rectangular impression at apex. *Dimensions*: 20 × 8 mm.

Labels: 1, 2, 3, costatus d'Urville; 4, 5, Phalidura [struck out] costata, d'Urville, h. in Nova Hollandia, D. Lesson; 6, Type T. costatus.

I have compared the three types together, and can find no reason for separating them. The *Amycterus Kirbyi* of Guérin and Boisduval is not this species, but belongs to the genus *Sclerorhinus* and probably to *S. subcostatus*, Macl.

TALAURINUS VERRUCOSUS Guérin.

Guérin, Voy. Coquille, ii. (2), p. 121; *A. verrucosus* Boisd., *l.c.*, p.372; *A. tuberculatus* Boisd., *l.c.* p.372.

Type, *Talaurinus verrucosus* Boisd., ♀—Elongate-elliptical, robust. Black, without clothing above, a few light-coloured scales in the centre below.

Head convex, forehead concave between the external rostral ridges. Rostrum short, at apex as wide as head, deeply excavate; external ridges convex in profile, continued on to forehead, constricted at point of junction; internal ridges obsolete; lateral basal sulci small, deep; median area depressed throughout. Scrobes curved, with posterior sinuosity. Eyes small, rounded. First and second funicular joints subequal; club short. Prothorax (6 × 7 mm.) widest in front of middle, obtusely angulate; apical margin with a slight postocular sinuosity; collar-constriction present, median line traceable at base; rather coarsely granulate, granules irregular in size and arrangement, more bunched together at angles; sides sparingly granulate below angles. Elytra (16 × 10 mm.) regularly rounded on sides; apex obtusely rounded, mucronate; base truncate, humeral angles prominent, tuberculiform; disc convex, with seven irregular rows of projections, granular towards base, becoming conical and tubercular posteriorly and laterally, intervals between rows not definitely striate nor foveate; sides obsoletely seriate-granulate. Beneath rather strongly convex; apical ventral segment with a short transverse linear impression subtended posteriorly by a small obtuse tubercle. *Dimensions*: 24 × 10 mm.

Labels: 1, 2, 3, Latreille; 4, 5, Phalidura [struck out] verrucosa d'Urville, h. in Nova Hollandia, D. d'Urville; 6.

Type, ♂ *T. tuberculatus* Boisd. Black, opaque, granules shining; a few scales in intervals between granules above, a median vitta of light scales branching into two along the internal rostral ridges.

Head and rostrum as in ♀. Prothorax (6 × 7 mm.) with more definite collar-constriction; more irregularly and coarsely granulate, roughly in four groups, one lateral and one along median line on each side, leaving three intervals (interstitiis tribus levibus). Elytra (15 × 9 mm.) rather narrower than in ♀, apex mucronate, base feebly emarginate, humeral angles tuberculiform; disc convex, feebly depressed along suture, granules and tubercles rather coarser and fewer in number than in ♀. Beneath concave; third and fourth ventral segments together equal to apical, fifth shallowly excavate, a deep transverse fossa present in posterior half, two small tubercles situated one on each side of the excavation. *Dimensions*: 23 × 9 mm.

Labels: 1, Nouv. Hollande; 2, Coll. Dejean, Coll. Roelofs; 3, tuberculatus d'Urville.

Both of these species should, I think, be referred to *Talaurinus verrucosus* Guérin. I have described both in some detail, as they vary rather considerably in the prothoracic and elytral granulation; this variation is, however, not sexual; the apical ventral segment does, on the other hand, shew sexual variation. The following table shows the variation in the number of the granules in each elytral row: —

	T. verrucosus.		*T. tuberculatus,*
Sutural row	20	(very small)	20
Second ,,	8, 9	(larger granules and tubercles)	5
Third ,,	15, 13	,,	9, 10
Fourth ,,	4, 6	(granules)	1
Fifth ,,	13, 12	(granules and tubercles)	9
Sixth ,,	9, 10	(conical tubercles)	8
Seventh ,,	13	(small granules)	7

Guérin's type appears to be a male; the dimensions are: long. 23, l. 8 mm. *T. scabrosus* Macl. is closely allied, but is a much more densely clothed species; the granulation also appears to be coarser.

Although not labelled type, I regard the specimen of *T. tuberculatus* as such, and think that the type-label has been attached in error to a *Psalidura* (*P. mirabunda*, Gyll.) sent for examination, and bearing a type-label: "Phalidura [struck out] tuberculata d'Urville, h. in Nova Hollanda, D. Lesson." The *Psalidura* in no way corresponded to the short concise description of Boisduval, which moreover agreed perfectly with the specimen here described.

TALAURINUS BUCEPHALUS Oliv., Masters' Cat. No. 4687.

Among the species sent for examination, was a specimen bearing the following labels:—

1, Nouv. Hollande; 2, Coll. Dejean, Coll. Rœlofs; 3, Bucephalus Olivier; 4, Type; 5, Phalidura [struck out] bucephala d'Urville, h. in Nov. Holland. D. Latreille; 6, Type T. bucephalus.

This specimen must be regarded as the true *T. bucephalus*, Oliv., and while evidently the specimen Boisduval had before him (Collection de M. Dejean), I do not think it can be regarded as Olivier's type, which was from the Muséum d' Histoire Naturelle.

The species is extremely common in the neighbourhood of Sydney, the Blue Mountains, and Moss Vale districts; and shews a range of variation which probably accounts for its extensive synonymy. The synonymy of Macleay's species has already been given by Lea under *T. Camdenensis*, Macl., and I have only to record their identity with *T. bucephalus*.

SCLERORHINUS CARINATUS Boisd., *l.c.* p.335.

? *Scl.* (*Hipporrhinus*) *nigrospinosus*, Don., Ins. New Holl. 1805; Boisd., *l.c.* p.335.

♀ Elliptical, convex. Black, opaque, densely clothed above with yellowish and ochraceous scales, granules not clothed; head with two longitudinal stripes on rostrum meeting behind on vertex, also a lateral supraorbital stripe on either side; prothorax trivittate.

Head convex, not constricted from rostrum, forehead flattened, median rostral linea prolonged on forehead. Rostrum short and thick, flattened above, not excavate; lateral sulci broad, moderately deep; median linea well defined, with a punctiform depression at junction with forehead. Eyes moderately large, oval. Club briefly obovate. Prothorax (4 x 5·5 mm.) transverse, rounded evenly on sides, apical margin feebly trisinuate, no median lobe, ocular lobes present; disc convex, finely granulate, granules irregularly arranged tending to leave three clear areas along vittæ; sides finely granulate. Elytra (11 x 7 mm.) ovate, evenly rounded on sides; apex gradually rounded, sharply mucronate; base truncate, humeral angles rectangular. Each elytron with three broad striæ densely clothed with whitish or yellowish scales, the lateral one subdivided by subhumeral interstice; interstices granulate, subcostate, granules semispinose, separate on declivity and laterally, setigerous; sutural interstice more or less prominent throughout, out-turned at base; second and third prominent, subcostiform in basal half, continued to base and apex; subhumeral with nine to eleven granules not reaching to base; lateral granulate, traceable only in basal half. Sides striate, interstices obsoletely granulate. The two central striæ of disc with two longitudinal rows of fine punctures, two lateral striæ each with a single row. Under surface gently convex. Apical ventral segment not excavate, finely pustulo-setose, with a faint median linear impression. Tibia strongly spinose beneath, outer ends bent not quite at right angles to shaft. *Dimensions*: 16 x 7 mm.

Hab.—New South Wales: Port Jackson (Boisduval).

Labels: 1, 2, 3, 4, 5, Phalidura [struck out] Amycterus carinata d'Urville, h. in Nova Hollandia, D. Lesson; 6, Type *P. carinata*.

Agrees very closely with description and figure of *Hipporrhinus nigrospinosus*, Don., but as I only know this species from the figure, I hesitate to sink Boisduval's name. *H. nigro-spinosus* is certainly a *Sclerorhinus*.

SCLERORHINUS BUBALUS Oliv., Ent.v.83,p.399,t.25,f.354. *Scl.* (*Amycterus*) *morosus* Boisd., *l.c.* p.386; Masters' Cat., No. 4877.

Type, *Scl. morosus*, Boisd., ♀—Small, narrow, elliptical, convex. Black, rather densely clothed above with brown scales, granules not clothed, below with a spare median vitta of yellow hair; head with dense brown scales, a central vitta of more golden scales dividing into two on rostrum, and a supraorbital stripe on each side.

Head convex, separated from rostrum. Rostrum very short, at apex as wide as head; not excavate; external ridges parallel, not extending on to forehead; lateral sulci shallow; median linea prominent, not continued on to forehead. Scrobes deep, open posteriorly. Eyes relatively large, subrotund. Antennæ long, first and second funicular joints subequal, club elongate. Prothorax (4 × 5 mm.) rounded on sides, widest across middle, subangulate; apical margin with a feeble postocular sinuosity; disc convex, granules small, scattered, median and two lateral longitudinal impressions faintly traceable; sides granulate. Elytra (9 × 6 mm.) gently rounded on sides; apex gradually rounded, mucronate; base truncate, humeral angles marked by small granules. Disc with six irregular longitudinal rows of punctures, interstices flat, for the most part not raised; sutural interstice slightly raised at base; second with two small granules near middle of elytra; third with four near base, and two or three more posteriorly; fourth without granules; fifth with thirteen closely placed granules; sixth with about fourteen; seventh lateral, not so distinct, with about as many granules as the sixth. Sides rugosely, irregularly, somewhat obsoletely granulate. Feebly convex below; fifth ventral segment with a faint transverse impression behind apex. Legs moderately long, light. *Dimensions*: 14 × 6 mm.

Hab.—Tasmania.

Labels: 1, Terra Van Dieman; 2, Coll. Dejean, Coll Roelofs; 3, morosus Dej.; 4, Phalidura [struck out] morosa, h. in Terra Van Diemen, D. d'Urville; 5, Type; 6, Type C. morosus.

A common Tasmanian species, also found in Victoria. The male differs in being narrower, and in having the ventral segments flatter, with a narrow median vitta of dense black hair.

DESCRIPTION OF A NEW LAC-COCCID (GENUS *TACHARDIA*) FROM NEW SOUTH WALES.

By Walter W. Froggatt, F.L.S., Government Entomologist.

Tachardia angulata, n.sp.

Adult ♀. Height, 4 mm.; diameter at base, 4 mm.

General colour bright red, apex shining, anal appendages and lac- or air-tubes tipped with black. Cephalic portion flattened, resting against the bark of the stem of the food-plant, irregularly wrinkled, with the mouth in the centre, lobed on either side. Anal tube projecting, fringed with a tuft of fine bristle-like hairs, with a fine spine standing out above the anal tube. Lac- or air-tubes longer and more slender than the anal tube, situated on either side, and projecting well beyond the lobed margin. General form cone-shaped, rounded at the apex.

Wax-test enclosing ♀ dark red to black in colour, broad and rounded at the base, coming to a blunt point at the apex, when viewed from above it is seen to be fluted, with four distinct ridges meeting at the summit. Outer surface smooth, with fine white filaments curling out through tiny apertures in the walls of the test. In general appearance resembling a large blunt rose-thorn; sometimes solitary, at other times in groups of three or four, in contact at the base. Height of test ¼ of an inch; diameter at base ⅛ of an inch.

Hab.—Eden, N. S. Wales, Reah River (Mr. G. J. Darke); on quince trees : Milton, N. S. Wales, also on quince trees.

ORDINARY MONTHLY MEETING.

May 31st, 1911.

Mr. W. W. Froggatt, F.L.S., President, in the Chair.

Miss H. **Beaumont**, Mosman; Miss H. A. **Dumolo**, Roslyn Gardens; Mr. **Sydney Dodd**, F.R.C.V.S., D.V.Sc., University of Sydney; and Mr. **Henry Hacker**, Queensland Museum, Brisbane, were elected Ordinary Members.

The President announced :—

(1) That a Citizens' Meeting, to further the interests of the Mawson Antarctic Expedition, would be held in the Vestibule of the Town Hall, on Tuesday, 13th June, at 4 p.m., the Lord Mayor in the Chair.

(2) That Professor David, B.A., F.R.S., C.M.G., would deliver a lecture on Antarctica, in aid of the Mawson Expedition Fund, in the Town Hall, on Friday evening, June 30th.

(3) That a communication had been received from the Fauna and Flora Protection Committee of South Australia, forwarded through the Royal Society of South Australia, asking for co-operation and support in an effort to have a portion of Kangaroo Island, comprising an area of 300 square miles, to be known as Flinders Chase, permanently reserved and vested in Trustees. The letter was read to the Meeting: and, on the motion of Mr. W. S. Dun, it was resolved unanimously, that a reply expressive of the Society's sympathy and support should be sent; and, on the motion of Dr. H. G. Chapman, it was resolved further, that Dr. R. Pulleine, of Adelaide, should be asked to represent the Society on the deputation which is to wait upon the Treasurer and Commissioner of Crown Lands, on 13th June.

The Donations and Exchanges received since the previous Monthly Meeting (26th April, 1911), amounting to 17 Vols., 96 Parts or Nos., 22 Bulletins, 8 Pamphlets, and 2 Maps received from 66 Societies, &c., and 2 Individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. D. G. Stead exhibited examples of the Blue-Eye, *Pseudomugil signifer* Kner, from Wamberal Lagoon, N. S. Wales, living in both sea-water, and pure, fresh water. These were part of a number obtained, during April, from the lagoon, at a spot where the water was "sweet" or brackish. These were brought away in that water, and, on April 19th, one was placed in an aquarium of sea-water (of about three years' standing), and the others were put into a freshwater aquarium. All had done well up to the present; the one in salt water, equally with those in fresh. This is an interesting experiment, inasmuch as it demonstrates the power of this little species to withstand sudden changes in its surrounding element. The coastal lagoons are very rich in this species, and these lagoons become practially fresh, and very salt alternately; it is, therefore, greatly to the advantage of this (and other species of aquatic life present) if they can adapt themselves to the varying conditions.

Miss Hynes exhibited some excellent diagrams of characteristic native plants, reproduced from drawings by Mrs. Ellis Rowan, portion of a series now in course of publication for the Department of Public Instruction, for use in the public schools Also a badge representing the Waratah, for field botanists, reproduced from a drawing by the same artist

Mr. H. L. White sent, for exhibition, a skull of the Native Bear, showing an extensive osseous growth commencing near the base of the skull and extending into the eye-cavity. From about 1875 to 1890, Native Bears (*Phascolarctus cinereus*) became exceedingly numerous in the neighbourhood of Belltrees, Scone. They eventually killed nearly all the Redgum-trees growing along the river-banks. From 1890 onwards, a marked decrease was noted, and now a Native Bear is a great rarity, in fact not a dozen had been seen during the last ten years. However, during the last few months several had been reported, and it may be that they were again on the increase. Mr. White adds:—"I am absolutely certain that, in this locality, a patch of well-timbered country, 30 by 15 miles in extent, these marsupials were not destroyed by any human agency, the number shot being very small indeed. I am quite satisfied that a disease of some sort practically exterminated the Native Bear in the Upper Hunter district. About 1895, the animals were dying off in hundreds, the poor brutes being noted on the ground, with their heads greatly swollen, and too weak to climb the trees. Their eyes were protruding; and numbers of skulls picked up later on, showed similar bony growths to that on the specimen exhibited. In 1896, I frequently visited a station in South-east Queensland; Native Bears were exceedingly plentiful in the locality, but disappeared in the course of a few years, and certainly not by shooting. During 1881-3, I was surveying on the South Coast, from Bega to the Victorian border, and noted the bears in hundreds, I understand that they disappeared in a mysterious manner, and not by shooting. In my opinion, it is not a fact that Native Bears were shot out, but that this fatal disease broke out amongst them when they became so numerous. The disease did not appear to affect the other marsupials. About 1896, the Opossums (*Trichosurus vulpecula*) commenced to die in large numbers, but there was no sign of swelled head, and the intestines were full of worms; the mortality did not last long, nor was it general, as in the case of the Native Bear. No disease of any sort has been noticed amongst the Kangaroos or Wallabies, but the Native Cat (*Dasyurus viverrinus*) has, like the Native Bear, practically disappeared, and during the same period of time."

Dr. T. Harvey Johnston exhibited a small series of Entozoa from New South Wales, comprising (1) *Cysticercus tenuicollis* Rud., from the mesentery of a goat (Illawarra district); (2) *Oxyuris ambigua* Rud., from the intestine of a rabbit (Braidwood, Cowra); (3) *Linguatula serrata* Frol., from the nasal cavities of dogs, obtained experimentally by introducing the larvæ (specimens of which were exhibited) of the parasite, found in the mesenteric glands of cattle from various parts of New South Wales. The three above-mentioned species, excepting No. 1 (from West Australia), had not previously been recorded from these hosts in Australia.

Mr. Cheel showed plants of, (1) *Acacia pugioniformis* Wendl., from Kensington, which produces new plants only from suckers; Mr. A. A. Hamilton and the exhibitor had watched the plants for seeds, for several years, without any success. (2) *Grevillea punicea* R. Br., which, under cultivation in the Botanic Gardens, sent out several suckers from which new plants were established, 2-3 feet from the parent-plants. (3) Flowering specimens of other plants of the same species were exhibited, showing twin styles in several of the flowers; this peculiar freak was first noticed by Mr. W. F. Blakely, in August, 1906, and again by the exhibitor, in September, 1910. (4) *Vitis clematidea* F.v.M., with enlarged yam-like rootstocks, from Wamberal and Peakhurst; the exhibitor's attention was first drawn to the tuberous growth of this plant, by Mr. L. Gallard, of Narara; it is also mentioned by Woolls, in Mueller's Fragm. v. 210. Mr. Cheel also stated that, during the past three months, the potato-blight (*Phytophthora infestans* De Barg) had caused great havoc among the potato-crops grown at Penshurst. The disease had been suspected of infecting other members of the order. Nevertheless, plants referable to six species—*Solanum jasminoides* Paxt., *S. nigrum* Linn., *S. armatum* R. Br., *S. cinereum* R. Br., *Datura stramonium* Linn., and *Physalis minima* Linn.—growing actually in the midst of the diseased potatoes, remained wholly unaffected, even though, on several occasions, spores had been sown on the leaves during showery weather or when otherwise damp.

Dr. Greig-Smith exhibited specimens of apples affected with Bitter Pit. The corky areas are remarkably sterile, and there is no diffusion of the pits, as might be expected if the disease were of microbic or fungoid origin. Some years ago Dr. Cobb suggested that the pitting might be a form of stigmonose, and the appearance strongly favours the suggestion that the pits are the result of some enzyme or poison injected by sucking insects. A mosquito, for example, with stylets and labium measuring $\frac{1}{13}$ inch, could pierce to the centre of the great majority of the pits.

Mr. Fred. Turner exhibited, and offered observations on *Panicum glabrum* Gaud (Syn. *Paspalum ambiguum* D.C.), which had been forwarded to him for identification, amongst a number of grasses, from near Ulmarra, Clarence River, a new record for this Indian species. Under ordinary conditions, this grass produces an abundance of seed, the vitality of which is not impaired in the process of digestion; and, in a great measure, that may account for its great dissemination, especially in the coast districts. Mr. Turner had cultivated, in Australia, many of the best fodder-grasses indigenous to Europe, Asia, Africa and America; and, although some of them had been thoroughly acclimatised for years, none of them spread so rapidly as the accidentally introduced *Panicum glabrum*.

Mr. North sent, for exhibition, an example of a small race of *Dacelo gigas* Boddaert, from the Jardine River, Cape York Peninsula, Northern Queensland, which he proposed to distinguish as a new subspecies, to be named after the collector, Mr. W. McLennan (Coll. MacGillivray). It bears a similar relation to *D. gigas* as does the Fawn-breasted Kingfisher to *D. leachii* A typical example of *D. gigas* was shown, for comparison.

Mr. Froggatt exhibited a specimen of a large wingless grasshopper, caught in a house at Mount Tambourine, Southern Queensland. It had invaded a mouse's nest, and, after frightening the mother away, was feeding upon a young one when captured.

Mr. Fletcher, on behalf of Messrs. C. T. Musson and W. M. Carne, showed examples of a phyllopod Crustacean (*Apus* sp.) found in a stormwater-drain in one of the paddocks of the Hawkesbury College farm, during the wet weather of last February. The occurrence of this Central Australian form so near the coast, is very remarkable.

THE BEES OF THE SOLOMON ISLANDS.

By T. D. A. Cockerell, University of Colorado, U.S.A.

(Communicated by W. W. Froggatt, F.L.S.)

Up to the end of 1910, only one species of bee had been recorded from the Solomon Islands, so I was naturally pleased to see the interesting series collected by Mr. Froggatt, in 1909. The recorded species (*Nomada psilocera*) was not in the collection, which consisted entirely of undescribed forms. As is well known, Australia possesses a rich bee-fauna, including many peculiar genera, which belong to the more primitive section of the Apoidea. It has, in addition, especially in the North-east, a series of long-tongued bees of Indo-Malay type, evidently representing a comparatively recent invasion. New Guinea, so far as is known, possesses an Indo-Malay bee-fauna, and this same fauna, variously differentiated as to species, spreads into the islands to the East. The Solomon Islands evidently possess a strong Indo-Malay element, but Mr. Froggatt's Collection brings out the interesting fact that there is also a genuinely Australian element, the most striking representative of which is *Meroglossa*, now for the first time found out of Australia.* It is certain that this Australian fauna must have reached the Solomon Islands by way of New Guinea, and it may be that further collecting in that island will reveal a number of Australian types; but it is perhaps equally likely that these, or many of them, have succumbed before the Indo-Malay invasion, leaving relics on the islands to the East and South-east. It is reasonable to suppose a period of elevation, permitting the Australian fauna to reach New Guinea, etc., followed by a period of great elevation to the North, resulting in an influx of Indo-Malay genera, most of them strong fliers, and quite capable of crossing narrow arms of the sea.

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* Some of the green species of *Prosopis* from New Guinea, &c., may prove to belong to *Meroglossa*. This is especially likely in the case of *P. imperialis* Smith.

I have prepared a list of the bees known from the islands East and South-east of New Guinea, 46 in all. It will be seen that 22 species are recorded from the Bismarck Archipelago, including New Britain (with New Pomerania) and New Ireland; sixteen from the Solomons, one from the New Hebrides, and eight from New Caledonia. Only one (*Megachile australasiæ*) is said to be common to any two of these groups. All the species from the Solomons and the one from the New Hebrides are endemic. Of the New Caledonia species, five are endemic; and one of those not so, the honey bee being certainly an introduction. The remaining two may perhaps not be correctly identified, especially the *Halictus*, otherwise known from Australia. In all these islands, the Colletid bees, so conspicuous in Australia and New Zealand, seem to be absent. The Xylocopids seem not to go beyond the Bismarck Archipelago.

It is obvious that additional collecting in these islands will produce a great number of undescribed species.

Abbreviations: S.m. = submarginal cell; r.n. = recurrent nervure; t.c. = transversocubital nervure; t.m. = transversomedial nervure.

MEROGLOSSA TETRAXANTHA n.sp.

♀ Length about 7½ mm.; head and thorax lemon-yellow, with black markings, the cheeks, prothorax and pleura wholly yellow; mandibles yellow, dark at extreme apex; mouth-parts prosopiform; clypeus with a broad dark brown bar on each side; long yellow supraclypeal mark bottle-shaped, its apex reaching anterior ocellus; lateral face-marks extending as broad bands to the top of the head, where they end abruptly, not connecting with the yellow of the occiput;

vertex otherwise, and interval between supraclypeal and lateral marks black; upper part of black frontal area punctured, lower part smooth; scape honey-colour except at apex; flagellum black, dull pale brownish beneath except at base and extreme apex; mesothorax strongly and closely punctured, black with four broad even yellow stripes, the outer ones marginal; scutellum and postscutellum with a broad median black stripe; area of metathorax smooth and shining, with a median, slightly depressed, ferruginous spot; on each side of the area is a broad ferruginous band, and the truncation has a narrow ferruginous stripe; tegulæ honey-colour; wings moderately dusky; stigma piceous, nervures rufo-fuscous; first r.n. joining second s.m. very near basal corner; femora, and anterior tibiæ in front, yellow; knees, tibiæ otherwise, and tarsi honey-colour; abdomen honey-colour, flushed with yellow at sides of first three segments, first segment with a dark mark at base; last two segments black above and below.

Hab.—Solomon Islands, July-August, 1909 (W. W. Froggatt). Near to *M. flavomellea* (Ckll.). It belongs to a little group, hitherto known from Queensland, separable thus:—

Metathorax fluted; comparatively large species (9 mm.)..*melanura* (Ckll.)
Metathorax not fluted.............................. 1
1. Apex of abdomen purple..............................*basilura* (Ckll.)
Apex of abdomen black.............................. 2
2. Female clypeus narrow, without lateral dark bars; width of clypeus not greater than combined widths of lateral spaces between clypeus and eye..............................*flavomellea* (Ckll.)
Female clypeus broader, with lateral dark bars; width of clypeus much greater than combined widths of lateral spaces between clypeus and eye..............................*tetraxantha* Ckll.

HALICTUS FROGGATTI n.sp.

♀ Length about 6½ mm.; black, with little pubescence, the thorax above with very scanty inconspicuous hair, the abdomen without hair-bands or spots, and the hind margins of the segments dark like the rest; head broad, eyes broadly shallowly emarginate; clypeus broad, not produced; cheeks in lateral view narrower than eye; mandibles dark; clypeus and supraclypeal area shining, front minutely granular; antennæ dark; mesothorax and scutellum dull, very minutely punctured, scutellum slightly bigibbous; area of metathorax large, dull, with an exceedingly minute subcancellate sculpture; legs black, small joints of tarsi reddish, anterior tarsi slender; tegulæ ferruginous: wings hyaline, nervures and stigma dark fuscous; second r.n. and third t.c. much weakened; third s.m. short, combined areas of second and third not so great as that of first; abdomen broad, shining, caudal rims dark ferruginous. Microscopic characters are as follows: frontal punctures much smaller than eye-facets, as dense as possible, running more or less into grooves; mesothorax very minutely granular, with widely scattered small punctures; area of metathorax finely irregularly reticulate; spurs ferruginous.

Hab.—Solomon Islands, July-August, 1909(W. W. Froggatt). In Friese's table of New Guinea species, this runs to *H. latitarsis* Friese, but that is easily distinguished by the broadened anterior tarsi. *H. froggatti* is closely allied to *H. sturti* Ckll., from Queensland, and looks just the same superficially, but the sculpture of the metathorax is quite different.

HALICTUS VIRIDISCITUS n.sp.

♀ Length about 8 mm., wings rather short; head and thorax granular, olive-green, the mesothorax and scutellum a stronger, bluer green; head broad; keel between antennæ prominent; front dull and granular, but the dense punctures much larger than the eye-facets; clypeus with large shallow punctures, black, the upper margin green, the border between the green and the black rosy; lower margin of clypeus with orange hairs; mandibles dark; cheeks in lateral view about as broad as eye; antennæ dark; mesothorax and scutellum very densely and finely punctured on a rugose ground; area of metathorax with very fine striæ, crossed by little ridges, giving a subcancellate effect; legs black; hind spur with four blunt teeth, the first two large; tegulæ piceous; wings strongly dusky; stigma dark reddish, nervures piceous; third t.c. and second r.n. almost obsolete; third s.m. very short, higher than long; abdomen shining dark green, the hind margins of the segments broadly blackened; apical hair dark reddish; large large ventral pollen-collecting hair-fringes.

Hab.—Solomon Islands, July-August, 1909(W. W. Froggatt, No. C 13). Related closely to *H. flindersi* Ckll., from Queensland, but conspicuously differing in colour, and in the sculpture of the metathorax.

HALICTUS EXTERUS n.sp.

♀ Length slightly over 6 mm.; head and thorax shining, dark green, with yellowish hair; head and mesothorax olive green, the other parts a bluer green; head broad, clypeus rather prominent, smooth and sparsely punctured; supraclypeal area smooth and shining; front finely striate, the striæ in front of the middle ocellus transverse; antennæ dark, the flagellum dusky reddish beneath; cheeks in lateral view as broad as eyes; mesothorax and scutellum smooth and shining, with scattered punctures; mesothorax with a lightly impressed microscopic linear sculpture, and some slight transverse ridges anteriorly; area of metathorax with very irregular ridges; trochanters and femora black, tibiæ and tarsi rich ferruginous; hind spur minutely pectinate; tegulæ shining rufopiceous; wings hyaline, faintly dusky, stigma piceous, nervures fuscous; abdomen shining dark bluish-green, without hair-bands or spots; hind margins of segments slightly reddish; no ventral polleniferous fringes.

Hab.—Solomon Islands, July-August, 1909, 2 ♀'s (W. W. Froggatt, No. C. 14). Apparently related to *H. ralunicola* Friese, from the Bismarck Archipelago, but that species has red-yellow mandibles, and the red of the legs includes practically all of the femora. I do not know any very near relative in Australia.

NOMIA FROGGATTI, n.sp.

♀ Length 11 mm. or slightly over; robust, black, the hind margins of the first four abdominal segments with pale orange tegumentary bands, flushed with emerald-green laterally (one specimen has the bands bright terracotta red, but they have probably been altered by cyanide); head and thorax above with bristly black hair, at sides and beneath with pale yellowish hair, but some black on upper part of pleura, middle of tubercles, and face (especially at sides) down to about the middle; abdomen with pale hair at base, otherwise with black, the black hairs overlapping the bands; venter with light reddish hair; legs with hair partly light reddish, partly black; black on outer side of hind tibiæ, reddish on inner side, contrasting; middle femora at base beneath with a stiff brush of orange-red hair (exactly the same in the Indian *N. elliotii*); clypeus rough, with a delicate median keel; mesothorax dull and very densely punctured; scutellum slightly bigibbous: postscutellum armed as in *N. elliotii*, but very much less light tomentum; base of metathorax with evident cross-keels (in *N. elliotii* they are nearly obsolete); abdomen rough, closely punctured (in *N. elliotii* very sparsely); tegulæ piceous: wings strongly dusky; first r.n. joining the small second s.m. beyond middle.

Hab.—Solomon Islands, July-August, 1909, 2 ♀'s(W. W Froggatt, No. C 12). An Indo-Malayan type, of the group of *N. elliotii* Smith. It is really known from *N. pulchribalteata* Cameron, by the different postscutellar armature, that, in Cameron's species, consisting of more widely separated, spine-like structures. In *N. pulchribalteata*, the truncation of the metathorax is shiny, with distinct punctures, largely in rows; in *N. froggatti* it is dullish, minutely granular and finely tomentose, with small, scattered punctures. Friese records *N. elliotii* from Key Island, but, as he says the female is without a green band on the first abdominal segment, it is evident that he has a distinct species..

CROCISA GEMMATA n.sp.

♀ Length about 13½ mm.: black, with exceedingly brilliant, shining blue markings; scutellum ⏞ -shaped (hind margin); clypeus with dense small punctures; keel between antennæ very strong; upper half of clypeus, supraclypeal area, sides of face almost up to ocelli, and narrow posterior orbits, all covered with blue hair; third antennal joint about as long as fourth; thorax marked with blue as follows, a large round patch on pleura, two elongate marks on upper part of prothorax, and two almost contiguous with them on mesothorax, median spearhead-shaped mark on mesothorax in front, and four large mesothoracic spots (the anterior discal, the posterior marginal); scutellum with small inconspicuous punctures, wholly without spots, and without any pale tuft from beneath margin; hair of occiput all black: tegulæ black; wings very dark fuscous, shining purple; anterior tibiæ blue on outer side, but on middle and hind tibiæ only the basal part is blue; abdomen rather elongate, all the blue bands very broadly interrupted; first segment with large blue quadrate patches, slightly emarginate on inner side; blue of fifth segment much reduced; venter black.

♂ Length about 11½ mm.; quadrate marks on sides of first abdominal segment strongly incised medially; hind femora with a large sharp thorn-like tooth beneath.

Hab.—Solomon Islands, July-August, 1909(W. W. Froggatt, No. C 1). This is extremely close to *C. emarginata* Lep., from New Ireland. It differs from Lepeletier's description of *C. emarginata* in the larger size, and the total absence of any line of blue hair on each side of the mesothorax next to the wings. It also differs in the absence of any blue markings on the tarsi. According to Friese, the male of *C. emarginata* has no tooth on the hind femur, and Lepeletier mentions no tooth. As, however, Friese says the blue markings are dull, not shining, it is evident that his "*emarginata*" is wrongly identified. In Friese's table, *C. gemmata* runs to

C. quartinæ, which is readily separated by the abdominal markings.

ANTHOPHORA SAPIENS n.sp.

♀ Length about 15 mm., robust, though not quite so robust as *A. emendata gilberti*, to which it runs in my table (in Ann. Mag. Nat. Hist., Oct., 1905, p.394); hair of head and thorax about as in *A. gilberti*, except that the hair of clypeus is all very dark fuscous; that of thorax above is rust-red mixed with black; clypeus densely punctured, black, except for three very obscure yellowish spots near the lower margin; supraclypeal mark almost entirely obsolete; lateral face-marks consisting of short whitish bands running close to clypeal margin; labrum with a very broad dull yellowish-white band, occupying nearly half its surface; mandibles with a large pale yellow patch; scape wholly dark; flagellum red at extreme apex; tegulæ ferruginous; wings strongly brownish, shorter than in *A. gilberti:* venation normal; hair on outer side of hind tibiæ light red, without any dark streak, on inner side black; abdominal bands brilliant pale greenish-golden, flushed with pink at sides, that on first segment narrow; ventral hair-bands black or dark fuscous in middle, pale yellowish at sides; apical hair of fifth segment dark rufous (in *A. gilberti* black, with white at sides); apical plate broader at end than in *A. gilberti.*

♀ **Var.** α. Clypeus with a light reversed T: abdominal bands coloured as in *A. gilberti*, though somewhat narrower; hair of clypeus dark as in type; hair of labrum dark fuscous (white in *A. gilberti*); fifth abdominal segment with hair coloured nearly as in *A. gilberti:* apical plate narrow, about as in *A. gilberti.*

Hab.—Solomon Islands, July-August, 1909(W. W. Froggatt, No. C 2; var. α, No. C 3). A member of the *A. zonata* group, related to the Australian *A. gilberti*, and to *A. ternatensis* from Ternate. The variety, represented by a single specimen, rather badly worn, approaches *A. gilberti* quite closely. It is, however, certainly conspecific with *A. sapiens.*

CŒLIOXYS DISPERSA n.sp.

♂ Length about 11 mm.; black, shining, the pubescence creamy-white, more decidedly ochreous-tinted on face; eyes dark reddish; clypeus not keeled, although there is a fine shining line on its upper part; front coarsely rugoso-punctate; vertex with a line of punctures along orbital margin, a curved depression next to each outer ocellus, and some very large irregularly placed punctures between; cheeks not wholly covered with hair; a narrow hair-lined sulcus along lower part of posterior orbits; mesothorax with strong scattered punctures on a shining ground; scutellum well-punctured at sides, little punctured in middle, the hind margin elevated, with a small shallow median notch, the lateral teeth sharp, only moderately long; area of metathorax dullish and granular, plicatulate basally; scutellum with two oblique basal pencils of light hair; tegulæ shining black; wings dark fuscous, except the basal region, which is broadly paler; legs with short white hair, tarsi dark rufous, with pale orange hair on inner side; abdomen with strong scattered punctures, much shorter than those of thorax; hair-bands white, lateral only, very narrow; apical segment rather short, six-toothed, lateral teeth long and spine-like, lower apical longer than upper.

Hab.—Solomon Islands, July-August, 1909(W. W. Froggatt, No. C 11). Belongs to a little group with *C. albolineata* Ckll., from Queensland and *C. biroi* Friese, from New Guinea. *C. dispersa* differs from *C. biroi* by the colour of its pubescence, larger size, and apparently other details; it is very distinct from *C. albolineata* by the darker wings, reduced abdominal markings, larger punctures of mesothorax, etc. The New Guinea *C. weinlandi* Schlz., (*albiceps* Friese) is not related.

CŒLIOXYS PEREGRINATA n.sp.

♀ Length about 12 mm.; black, head and thorax densely punctured, pubescence dull pale rust-red; clypeus and supraclypeal area coarsely roughened, convex, not at all keeled; antennæ black; eyes reddish; cheeks narrow, with no distinct groove; mesothorax and scutellum extremely densely punctured, the latter slightly angled in the middle behind, not at all emarginate, the lateral teeth rather short; sides of mesothorax and two spots at base of scutellum conspicuously covered with red hair; tegulæ shining black; wings strongly fuscous, the basal part hyaline; legs black, with reddish hair; abdomen long, shining, with strong irregular well-separated punctures, and entire ferruginous hair-bands; last dorsal segment pointed, with a median keel, becoming a mere smooth line on the basal half; last ventral extending beyond dorsal, pointed, not notched at the sides; fifth ventral segment with very small punctures, the segments before with large punctures. The last ventral is formed as in *C. brevis* Eversm., though rather broader; the last dorsal is more elongate than in *C. brevis*.

Hab.—Solomon Islands, July-August, 1909(W. W. Froggatt, No. C 10).

The following table shows the relationship of this species to those of Australia and New Guinea.

Face with a prominent longitudinal ridge, which extends from the anterior ocellus to the apical margin of the clypeus (New Guinea) ... .*smithii* Dalla Torre.
Face without such a ridge ....1.
1. Apical margin of scutellum emarginate in the middle....................... .. . ...*albolineata*-group (see above).
Apical margin of scutellum not emarginate...... ...2.
2. Wings extremely dark, brilliantly violaceous; head with much white hair; lateral teeth of apical segment of male abdomen rudimentary... ....*weinlandi* Schulz (*albiceps* Friese).*

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* This is a comparatively large species, the males 12 mm. or a little over, the females about 16 mm.; but a single male collected by Mr. Froggatt at Cape York, Queensland, is only a little over 10 mm. long.

Wings dark in some, but not so violaceous; head if white-haired, less conspicuously so; lateral teeth of apical segment of male abdomen well-developed (unknown in *C. peregrinata*, but it has the hair of the head ferruginous).......................... .... 3.

3. Pubescence ferruginous; last ventral segment of female abdomen without lateral notches... ....*peregrinata* Ckll.

Pubescence white.............. . ...4.

4. Larger; wings darker; last ventral segment of female abdomen deeply notched on each side; abdominal hair-bands lateral only (Queensland)...................... ....*reginæ* Ckll.

Smaller, length of ♀ hardly 10 mm., of ♂ 7½; last ventral segment of female abdomen barely notched; white abdominal bands entire or very slightly interrupted; eyes pale green; scutellum with two large white hair-spots, sometimes absent (rubbed off?); wings with the apical field pale brownish [Victoria (Froggatt, 57.)]................. ....*froggatti* Ckll., n.sp.[†]

MEGACHILE MENDANÆ n.sp.

♀ Length about 16 mm., width of abdomen 5; shape about as in *M. lucidiventris* Smith, the abdomen large and thick, but of the parallel-sided type; hair of head and thorax bright fox-red, paler below, red also on sides of first abdominal segment; rest of abdomen with very short black hair, ventral scopa black; hair of legs scanty, ferruginous on femora, otherwise mainly black or dark fuscous, but red on inner side of hind tarsi, and largely so on inner side of middle ones; head large, inner orbits with a double curve, the eyes diverging below; mandibles with two teeth, and a broad cutting edge within; clypeus short, transverse, coarsely rugose, slightly keeled, the lower margin gently convex, with a pair of small widely separated tubercles; hair of clypeus red, but inconspicuous; antennæ black; cheeks densely punctured; mesothorax minutely and densely rugoso-punctate, with scattered larger punctures; scutellum densely covered with short bright red hair, its surface hidden; hind basitarsus not greatly broadened; tegulæ dullish black; wings dark fuli-

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[†] Additional particulars concerning *C. froggatti* will be given in a paper dealing with Australian bees.

ginous; abdomen with scattered punctures, and the first three segments minutely rugoso-punctate, the fourth and fifth smoother; second joint of labial palpi a little longer than first; tongue extending far beyond palpi.

Hab.—Solomon Islands, July-August, 1909(W. W. Froggatt, No. C 4). This and the following species are named after explorers connected with the Solomon Islands. This is a very fine species, of Austro-Malay, not Australian, type. Superficially, it looks much like *Chalicodoma sicula* Rossi. It appears to be related to the Hawaiian *M. schauinslandi* Alfken, but the latter is smaller, with the ventral scopa mainly pale, the first dorsal segment densely red-haired right across, and otherwise different.

MEGACHILE BOUGAINVILLEI n.sp.

♂ Length about 9½ mm., narrow, with parallel-sided abdomen; black, with the legs, except the coxæ, entirely bright ferruginous red, with pale orange hair; anterior coxæ spineless, black with an obscure red spot; head quite large, eyes red, quite strongly converging below; antennæ black, long and slender, the flagellum crenulated; mandibles thick, the broad outer face rugose; clypeus with large dense punctures, middle of lower margin broadly excavated; hair of middle of face black, but of lower part of clypeus golden; vertex, mesothorax and scutellum with black hair, but a fringe of pale yellowish hair in front of thorax, and one behind scutellum; metathorax and pleura with light yellowish or orange hair; mesothorax and scutellum dullish, very densely punctured; area of metathorax minutely granular; spurs light red; tegulæ black; wings dusky; abdomen densely rugoso-punctate, with scanty ferruginous hair, which forms obscure bands; sixth segment rounder, shallowly emarginate in middle; no subapical ventral teeth.

Hab.—Solomon Islands, July-August, 1909(W. W. Froggatt, No. C 9). Related to *M. austeni* Ckll., from Queensland, but the latter has black legs, white hair on face, etc.

MEGACHILE SHORTLANDI n.sp.

♀ Length about 14 mm., broad, shaped as in *M. chrysopyga* Smith; black, including legs, mandibles, antennæ and tegulæ; head and thorax with fox-red hair, that on mesothorax thin and mixed with fuscous; head large; eyes dark reddish; mandibles massive, quadridentate, the third tooth very broad and low; clypeus and supraclypeal area strongly, very densely punctured, the former with a broad median smooth band; lower edge of clypeus straight, but flaring; mesothorax and scutellum very densely punctured; hind basitarsus broadened; hair of legs white, reddish and black; on hind tibiæ and basitarsi the hair in front and on outside is white or yellowish-white, and quite long, posteriorly it is shorter and black, it is also black on inner side of basitarsus, but the inner side of the tibiæ is covered with fine white tomentum; wings strongly dusky: marginal cell not at all appendiculate; abdomen above shining black, well punctured, with short black hair; first segment with thin fulvous hair, and a patch on each side; segments 2 to 5 with inconspicuous linear fulvous hair-bands, failing in the middle; ventral scopa pale fulvous on second segment, on third and fourth bright red, black at sides, on fifth and sixth black. (Froggatt, C 5; type).

♂ Length slightly over 12 mm.; mandibles tridentate; face covered with light orange hair, but upper part of clypeus with a good deal of fuscous; thorax above with rufous hair, strongly mixed with black on scutellum and disc of mesothorax; anterior coxæ with very short spines or tubercles; anterior tarsi simple; hair-bands of abdomen dull white, none on fourth segment; sixth segment descending, the margin with two widely separated broad triangular teeth; no subapical ventral teeth; pale tomentum on inner face of hind tibiæ very conspicuous. (Froggatt, C 8.)

Hab.—Solomon Islands, July-August, 1909(Froggatt, C 5, and C 8). This has a rather strong superficial resemblance to the Indian *M. griseopicta* Rad., though very different in detail.

MEGACHILE CARTERETI n.sp.

♂ Length about 13 mm.; shape much as in *M. lanata* (Fabr.), but head larger, and abdomen broader in middle; coloration much as in *M. rotundipennis* W. F. Kirby, the quite long and abundant pubescence rust-red; eyes black, converging below; face covered with red hair; no admixture of black or fuscous hair on head or thorax, except a little at sides of vertex; mandibles with three strong teeth; mandibles and antennæ black; tegulæ reddish-black; legs black, with anterior femora, tibiæ and tarsi red in front, middle tibiæ mainly red in front; hair of legs mainly red, inner side of hind tibiæ with greyish-white hair; anterior coxæ with large spines; anterior tarsi slightly flattened, with a large oval black spot on inner face; vertex, mesothorax and scutellum closely punctured; wings dusky, reddish; abdomen with long red hair, not wholly covering the surface, leaving a banded effect; sixth segment retracted, with a strong median keel-like prominence; the margin turned outwards, irregularly denticulate, with a shallow median emargination; no evident subapical ventral teeth; spurs red.

Hab.—Solomon Islands, July-August, 1909(Froggatt, No. C 7). Related to *M. ustulatiformis* Ckll., from Queensland, but distinguished by the red hair of face, keel-like prominence on sixth abdominal segment, etc.

MEGACHILE WOODFORDI n.sp.

♀ Length about 10 mm.; black, including mandibles, antennæ, tegulæ and legs; form broad, abdomen shovel-shaped, general appearance almost exactly like *M. chrysophila* Ckll., from Mexico; face broad, eyes moderately converging below; mandibles quadridentate; clypeus extremely densely punctured, and with a very broad and shallow median apical emargination; a smooth shining patch occupies the lower part of the supraclypeal area and the upper margin of the clypeus; hair of face below antennæ, and of vertex, black, but a sort of broad V-shaped band on front pale yellowish; cheeks with hair black in front and pale behind; front densely punctured, but rather shining; mesothorax and scutellum dull, minutely and very densely rugoso-punctate; hair of mesothorax and scutellum black, but cream-coloured tomentum in the suture between them; other parts of thorax with pale yellowish hair, but a good deal of black on upper part of pleura; legs with reddish hair, that on tarsi bright fox-red; hind basitarsus much broadened and flattened; spurs red; wings dusky; abdomen black, with short black hair, the hind margins of the segments with conspicuous entire orange-fulvous hair-bands; ventral scopa bright red. (Froggatt, C 6; type.)

♂ Length about 10 mm.; hair of face light golden, with some dark hairs intermixed on upper part of clypeus; hair of vertex black, of cheeks long and pale yellowish; antennæ long, black; hair of thorax ferruginous, pale yellowish below, disc of mesothorax and scutellum with black hair: abdomen with red bands as in female; anterior coxæ with short sharp spines; anterior tarsi simple, dark reddish; sixth abdominal segment with outstanding margin bilobate, the lobes rounded; no ventral spines.

Hab.—Solomon Islands, July-August, 1909 (Froggatt, No. C 6). Related to *M. diligens* Sm., from the Hawaiian Islands, and *M. doanei* Ckll., from Tahiti. The male *M. doanei* has the sixth abdominal segment bidentate instead of bilobed, and the fifth is covered with red hair. *M. diligens* is easily separated by the colour of the thoracic pubescence.

The following key separates the species of *Megachile* of the Solomon Islands, New Caledonia, New Britain, etc.

Males ....i.
Females ....ii.

1. Legs, except coxæ, red; small narrow species.........*bougainvillei* Ckll.
Legs at least largely black...............................2.

2. Abdomen black without markings; face with much creamy-white hair, but upper part of clypeus with black; wings dark fuliginous ....*lachesis* Smith.
Abdomen otherwise, or face not so marked ....3.

3. Black, with black hair, abdomen pale rufo-testaceous beneath; wings subhyaline........................*ventralis* Smith.
With at least some conspicuous light hair.............4.

4. All the tarsi reddish-testaceous; length 9½ mm..............*quodi* Vachal.
At least some of the tarsi dark ....5.

5. Anterior coxæ not toothed; wings nigro-violaceous; length 13 mm.; species resembling *M. lachesis*, but abdomen with some rufous.....................*megitsia* Cameron.
Anterior coxæ toothed (teeth rudimentary in *M. shortlandi*), but wings not nearly so dark as in *M. megistia*................6.

6. Abdominal segments 5-7 entirely covered with fulvous or red hair...7.
Abdominal segments 5-7 not, or not entirely, so covered.................8.

7. Wings fuscous; thorax with black hair.................*placida* Smith, var. *nigrohirta* Friese.
Like *M. placida*, but apparently larger; perhaps not distinct...........................*othona* Cameron.

8. Wings fuscous; two apical segments of abdomen with ferruginous hair, but abdomen not banded...........................*mortyana* D.T.
Wings subhyaline; abdomen banded.......................9.

9. Hair of thorax above without black; anterior coxæ with large spines..................*cartereti* Ckll.
Hair of thorax above with much black.................10.

10. Hair-bands of abdomen white...........................*shortlandi* Ckll.
Hair-bands of abdomen red...............................*woodfordi* Ckll.

11. Large, entirely black; wings nigro-fuscous.................*lachesis* Smith.
Not entirely black.......................................12.

12. Ventral scopa silvery white (*australasiæ*) or reddish-white (*australis*)..13.
Ventral scopa fuscous or black ....14.
Ventral scopa red, or largely so..15.

13. Thorax above with six white hair-spots.....................*australis* Lucas.
Thorax not so marked; abdomen with pale yellow hair-bands ....*australasiæ* D.T.

14. Abdominal segments 2 to 4 orange-banded............ *aurantiaca* Friese.
Abdomen with two orange bands..............................*quodi* Vachal.
Abdomen without bands.....................................*mendanæ* Ckll.

15. Scopa red and black.. 16.
Scopa all red; face with black hair........................17.
16. Scopa bright red, black on last two segments; four conspicuous white spots forming a curved line between the wings...*albomarginata* Smith.
Scopa black at sides of third and fourth segments; no white spots between the wings...*shortlandi* Ckll.
17. Thorax with hair largely pale, especially at sides.......*woodfordi* Ckll.
Thorax with black hair..18.
18. Larger, 15 mm. long; first or first two abdominal segments black-haired, abdomen beyond this red-haired.....*placida* Sm., var. *nigrohirta* Friese.
Smaller; abdomen above black without red...............19.
19. Larger..*ventralis* Smith.
Smaller, but hardly separable from the description ....*similis* Smith.

TRIGONA SAPIENS n.sp.

Worker: about 4½ mm. long; black, head and thorax shining, without light markings; head large; labrum pale ferruginous; mandibles chestnut-red; antennæ light ferruginous, the flagellar joints stained with dusky above; face and front thinly, nearly uniformly clothed all over with dull white hair; hair of thorax and legs scanty, pallid; abdomen shining, dark rufo-piceous; stigma and nervures very dark reddish-brown.

Hab.—Solomon Islands, July-August, 1909 (Froggatt, No. C 18). Related to the Australian *T. carbonaria* Smith, but readily known by the pale reddish antennæ and mandibles, and the evidently hairy upper part of front. Also related to *T. canifrons* Smith, which it resembles in the colour of antennæ and mandibles, but in *T. canifrons* the face is covered with fine white tomentum, while the front is naked and shining. The abdomen of *T. canifrons* is considerably paler than that of *T. sapiens*.

I give a check-list of the bees known from the Bismarck Archipelago, New Caledonia, and all the groups between them. Type-localities are marked with an asterisk.

PROSOPIDIDÆ.

Meroglossa tetraxantha Ckll. Solomon Is.*

ANDRENIDÆ.

Callosphecodes ralunensis Friese. Ralun, Bismarck Arch.* Abdomen blue.

Halictus raluniwola Friese. Ralun, Bismarck Arch.* Green; 5 mm. long.

H. froggatti Ckll. Solomon Is.*

H. viridiscitus Ckll. Solomon Is.*

H. exterus Ckll. Solomon Is.*

H. urbanus baudinensis Ckll. New Caledonia, *fide* Vachal.

Nomia froggatti Ckll. Solomon Is.*

N. elliotii Smith. French Is.; New Ireland; New Pomerania; all det. Friese.

N. luteiventris Friese. New Pomerania*; Ralun, Bismarck Arch. Abdomen red.

N. variabilis triangulifera Friese. New Pomerania.

N. varialilis zebræ Friese. New Pomerania.*

N. fulviventris Cameron. Gazelle Peninsula (New Pomerania).*

N. willeyi Cameron (*N. metallica* Cam., *N. gazellæ* Friese). Gazelle Peninsula.*

N. pulchribalteata Cameron. Gazelle Peninsula.*

N. sicheli Vachal. New Caledonia.* (Vachal, in 1907, says ? ♀ of *N. argentifrons* Smith.)

NOMADIDÆ.

Nomada psilocera Kohl. Bougainville I., Solomon group.*

MELECTIDÆ.

Crocisa gemmata Ckll. Solomon Is.*

C. emarginata Lep. New Ireland;* New Britain.

C. quartinæ Gribodo. Gazelle Peninsula, *fide* Kohl.

C. pulchella Guér. New Ireland.* Described as a variety of *C. nitidula* Fabr.

ANTHOPHORIDÆ.

Anthorphora sapiens Ckll. Solomon Is.*

A. zonata L. New Britain, *fide* Cameron.

MEGACHILIDÆ.

Cœlioxys dispersa Ckll. Solomon Is.*

C. peregrinata Ckll. Solomon Is.*

Lithurgus dentipes Smith. New Pomerania, *fide* Friese.

Megachile mendanæ Ckll. Solomon Is.*

M. bougainvillei Ckll. Solomon Is.*

M. shortlandi Ckll. Solomon Is.*

M. cartereti Ckll. Solomon Is.*

M. woodfordi Ckll. Solomon Is.*

M. albomarginata Smith. New Caledonia.*

M. aurantiaca Friese. New Caledonia.*

M. australasiæ D.T. (*M. imitata* Sm.). New Caledonia and New Ireland, *fide* Friese.

M. australis Lucas. Nouméa, New Caledonia.*

M. lachesis Smith. New Ireland and New Pomerania, *fide* Friese. I have a male collected by Dahl at Ralun, Bismarck Archipelago.

M. mortyana D.T. (*apicata* Sm.). New Britain, *fide* Friese.

M. placida nigrohirta Friese. New Britain.*

M. similis Smith. Aneiteum, New Hebrides.*

M. megistia Cameron. New Britain.* ♂ 13 mm.

M. othona Cameron. New Britain.* ♂ 12 mm.

M. quodi Vachal. New Caledonia.*

XYLOCOPIDÆ.

Xylocopa provida Smith. New Pomerania, *fide* Friese. Hair of head whitish.

X. perkinsi Cameron. New Britain.* Hair of head black.

The record of *X. cærulea* Fabr., from New Caledonia is erroneous.

APIDÆ.

Apis mellifera L. New Caledonia, *fide* Vachal. Doubtless introduced.

Trigona sapiens Ckll. Solomon Is.*

REVISION OF *PTEROHELÆUS* (continued) AND OF *SARAGUS;* WITH DESCRIPTIONS OF NEW SPECIES OF AUSTRALIAN *TENEBRIONIDÆ.*

By H. J. Carter, B.A., F.E.S.

(Plate viii.).

Table of *Pterohelæus.* Subsection iii.

Elytra seriate-punctate, the interstices flat or slightly raised and narrow.
***1. Size large, 20 mm. long**..*P. memnonius* **Pasc.,**
....*P. tenuistriatus* **Lea.**
2.(22)Size medium, 14-16 mm. long.
3.(7)Colour black or brown-black, highly polished.
4. Sides parallel, form elongate..........................*P. parallelus* Brême.
5.(7)Sides not parallel, form ovate.
6. Metasternum pustulose..*P. sternalis,* **n.sp.**
***7. Metasternum not pustulose, elytral margins wider**...*P. fraternus* **Blackb.**
8.(12)Colour black, subnitid.
9. Alternate intervals of elytra faintly costate..........*P. confusus* **Macl.**
10.(12)Alternate intervals of elytra flat.
***11. Punctures in series very fine, confused at base**....*P. geminatus* **Blackb.**
***12. Punctures in series not fine, nor confused at base**...*P. bagotensis* **Blackb.**
13.(17)Colour black, opaque.
14. Form elongate-ovate..*P. planus* **Bless.**
....*P. peltoides* **Macl.**
15.(17)Form widely ovate.
16. Elytra costate..*P. ovulum* **H.-Rut.**
***17. Elytra not costate**..*P. silphoides* **Brême.**
18.(22)Colour brown.
19. Punctures in series large, intervals raised.............*P. litigiosus* **Pasc.**
20.(22)Punctures in series small, intervals flat.
21. Size larger (16 × 10 mm.), convex...........................*P. Broadhursti* **Lea.**
***22. Size smaller (14 × ? mm), depressed.**........................*P. servus* **Pasc.**
23.(34)Size small, less than 12 mm. long.
24.(27)Colour black, highly polished.
25. Size smaller (8 mm. long), punctures large and deep.........................
P. punctipennis **Macl.**
26. Size larger (10-11 mm. long), punctures very small..*P. nitidissimus* **Pasc.**
27. Size largest (12 mm. long), punctures moderate...........*P. cereus* **Macl.**
28.(30)Colour black, or piceous-black, moderately nitid.
29. Form oval and convex..*P. pusillus* **Macl.**

*** Species identified only from description.**

**30. Form depressed and elongate...................... *P. peltatus* Erichs.
31. Colour black, opaque................................ *P. asellus* Pasc.
32. (34) Colour brown or piceous.
*33. Size larger (10 × 6 mm.)............................ *P. ovalis* Blackb.
34. Size smaller (6 × 4 mm.)............................ *P. opatroides* Macl.

Pterohelæus, Subsection iv.

Elytra irregularly punctate.

1. (7) Colour black, highly polished.
2. (4) Form very convex.
3. Sides of elytra subparallel, sternum coarsely granulose......... *P. vicarius* Pasc.; *P. glaber* Macl.; (?)**P. ater* Blackb.; (?)**P. striato-punctatus* Boisd.
4. Elytra obovate, sternum minutely granulose......... **P. Kollarii* Brême
5. (7) Form less convex, elytral punctures smaller than in 3.
6. Size 14 × 8 mm., punctures larger.................. *P. obliteratus* Macl.
7. Size 10·2 × 5·8 mm., punctures very fine.................. *P. politus*, n.sp.
8. (13) Colour black, subopaque.
9. (12) Form very convex.
10. Elytral punctures large and dense.................. *P. convexiusculus* Macl.
11. Elytral punctures smaller, distant and obscure.... *P. subpunctatus*, n.sp.
12. Elytral punctures subobsolete........................ *P. sublævis*, n.sp.
13. Form more depressed, elytral punctures small........ *P. dispersus* Macl.
14. (18) Colour brown or reddish.
15. Elytra tuberculate.................................. ***P. minimus* Macl.
16. (18) Elytra not tuberculate.
17. Elytra broadly ovate, confusedly striate.............. *P. thymaloides* Macl.
18. Elytra subparallel, minutely, regularly costate....... *P. nitiduloides* Cart.

Synonymy.

P. vicarius Pasc. = *P. glaber* Macl. = *P. ater* Blackb. = *P. striato-punctatus* Boisd.(?).

Having compared the type of *P. glaber* Macl., with specimens of *P. vicarius* Pasc., (cotypes, *fide* Mr. Masters), I have no hesitation in saying that the species are identical. There seems to be little doubt as to the synonymy with *P. ater* Blackb. The Macleay Museum specimens (cotypes) of *P. vicarius* certainly show a slightly recurved margin to the thorax, while Pascoe's description of the elytra says "the punctures less regularly arranged near the suture and base." This is quite different from Mr. Blackburn's interpretation of it, "with the seriate punctures of the elytra interrupted *only* about the base and near the suture." Specimens of *P. vicarius* examined—it is the commonest species in the Sydney district—have irregular punctures interspersed with the seriate punctures to a slight degree. Pascoe also gives Victoria as one of the localities for *P. vicarius*. I have received specimens of it from various parts of Victoria, exactly corresponding with Mr. Blackburn's description of *P. ater*. Of *P. striato-punctatus* Boisd., I speak with the usual doubt that is associated with Boisduval's species. The description is useless, but De Brême's figure and fuller detailed description are quite consistent with the above synonymy; while many Museums in Europe have Pascoe's species labelled *P. striato-punctatus* Boisd. (There is a specimen in the Howitt Coll. of the Melbourne Museum, so labelled). Boisduval's locality was Kangaroo Island. While this doubt remains, it is better to retain Pascoe's name. I have transferred *P. vicarius* from Section iii. to Section iv., in the tabulation, which may be readily explained by its synonymy with *P. glaber* Macl. There are very few species that have not some indication of a linear arrangement in the elytral series of punctures; in fact, *P. nitiduloides* Cart., is the only species in which this arrangement is not traceable. The gradation between Subsections iii. and iv., of Macleay, are not, therefore, clearly defined; but in all the species tabulated in Section iv. above, the irregular punctuation of the elytra is not confined to the basal, sutural, and lateral regions.

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* Species identified only from description.

** *P. agonus* Pasc., is unknown to the author, and unrecognisable from description, but evidently comes near 30.

Macleay's Section ii., Subsection ii., is omitted here, having been revised and tabulated by the Rev. T. Blackburn (Trans. Roy. Soc. South Australia, 1907, p. 290).

P. silphoides Brême, may or may not be *Cilibe silphoides* Boisd. Macleay says that they are not identical, without giving any evidence for his opinion. I have three specimens taken by Mr. Hacker in the Cape York district, that exactly correspond with the figure and description given by De Brême, but are quite unlike the species labelled *P. silphoides* Brême, in the British Museum. While resembling many species of *Saragus* in the ovate convex form, my specimens are winged, and have the prothorax widely rounded, with wide flat margins, distinctly wider than the elytra at base.

P. dispersus Macl.—There is evidently some mistake in Macleay's published dimensions, given as 5½ × 3½ lines. The type measures 14 × 7 mm.

P. minimus Macl., belongs to Section ii., Sub-Section ii., but was omitted by Mr. Blackburn in his tabulation of the group (Trans. Roy. Soc. S. Aust. Vol. xxxi., 1907, p.291), following Macleay's arrangement.

PTEROHELÆUS SUBCOSTATUS, n.sp.

Subparallel, black, moderately nitid; palpi, antennæ and legs piceous.

Head impunctate, epistoma truncate with sides rounded and raised, limited behind by a fine semicircular suture, eyes much more approximate than in *P. piceus* Kirby; antennæ with basal joints slender, third joint little longer than fourth, four apical joints transverse and successively wider, thirteenth much the largest and ovoid.

Prothorax, 3·5 × 9 mm., length measured in middle, width at base; extreme border narrowly raised at apex and sides, apex rather squarely emarginate, anterior angles produced beyond the eyes and widely rounded, base slightly sinuate, sides moderately rounded, posterior angles acute, foliate margins wide and with the disc entirely impunctate, base rather deeply bifoveate, the foveæ joined by a transverse impression. *Elytra* as wide as prothorax at base, shoulders angular and obtuse, sides subparallel for two-thirds of length, margins wide, of almost equal width till near apex, then slightly narrowed, extreme border narrowly raised; disc with humeral boss prominent, with eight equally and slightly raised costæ on each elytron becoming obliterated at apex, besides a short scutellary costa; between each pair of costæ two rows of large closely set punctures (of about the same size but more closely set than in *P. piceus* Kirby), the costate intervals and the suture entirely lævigate; a single row of lateral punctures even more closely set than the preceding. Abdomen striolate, apical segment minutely and closely punctate; femora and under-side of margins smooth, tibiæ and tarsi fringed with short yellowish hair, prosternum carinate and produced backward. *Dimensions*, 16 × 10 mm.

Hab.—Brunswick and Patterson Rivers, New South Wales.

Two specimens, the sexes, are before me, the male taken by the author at Brunswick Heads, the female by Mr. A. Stephen in the Patterson River district. The former specimen has the costæ more distinct, those on the female specimen becoming obscured about half-way, but they are certainly conspecific. This species belongs to Macleay's Section i., and is nearest *P. piceus* Kirby, from which it differs considerably in (1) smaller size; (2) subparallel form, with margins scarcely widened in the centre; (3) more approximate eyes; (4) much more closely set punctures of elytral series, and more regularly raised costæ. From *P. Pascoei* Macl., it differs more markedly in the larger punctures and evident costæ. Like many others of the genus, fresh specimens are covered with a pruinose bloom. Types in the author's Coll.

PTEROHELÆUS STERNALIS, n.sp.

Elongate-ovate, subparallel, black, very nitid, antennæ and tarsi red.

Head coarsely punctured, slightly rugose at base, epistoma straight and depressed in front, rounded and a little raised at sides, not separated from forehead by a defined groove: antennæ long (extending to base of prothorax when at rest), basal joints slender, four apical joints much wider than preceding and rounded; apical joint elongate-ovoid. *Prothorax* more than twice as wide as long, widest at base, width at apex about equal to length, sides arcuately converging from base to apex, anterior angles emarginate and rounded, posterior angles acute and deflexed, margins rather flat and narrow, extreme border very fine and scarcely raised, base trisinuate with two equidistant foveæ, and two smaller foveæ, one on each side of scutellum; disc convex, finely and rather closely punctured, with central depression faintly indicated near the middle. *Scutellum* semicircular. *Elytra* three and one-half times the length of prothorax, and a little wider than it at base, sides parallel to half-way, then slightly expanded before the apex; shoulder obtuse, margins very narrow (narrower than in *P. vicarius* Pasc.), extreme border raised, disc seriate-punctate with about 18 rows of close, well-defined, round punctures, increasing in size from the suture outwards, besides some irregular smaller punctures on basal area; of these rows, the punctures in the first (excluding a short scutellary row of similar punctures) very fine and close, in the second and succeeding rows larger and more distant, the lateral row of punctures largest of all and deeply impressed; the intervals flat on disc, but becoming raised and convex towards the sides. *Prosternum* strongly carinate and produced backwards into the mesosternum in a wide V-shaped receptacle; meta- and episterna rather thickly studded with large punctured pustules, those on the former curved (or slug-shaped), on the latter round; *abdomen* with first two segments strongly longitudinally strigose and punctate, apical segment closely punctate only; fore tibiæ finely serrated on their outside edge, armed at apex with two short acute spines; tarsi clothed with pale red hairs. Penis grooved above and terminated by four minute spine-like processes. *Dimensions*, 16 × 8·5 mm.

Hab.—Goombungle, Darling Downs, Queensland.

A single specimen (♂) sent by Mr. C. French. It is most closely allied to *P. vicarius* Pasc., from which it differs *inter alia* by the more regularly defined seriate punctures of the elytra, and in the sculpture of the sternum. In *P. vicarius* Pasc., the sternum is closely and regularly pustulose, the pustules being little raised; in *P. sternalis* the pustules are much larger, more distant and more defined. *P. geminatus* Blackb., must be another ally, with evidently finer elytral sculpture "finer than those of *P. nitidissimus* Pasc."; while in *P. sternalis* the punctures in the series (except in the first row) are larger even than in *P. vicarius* Pasc.

I have never met with specimens of *P. vicarius* Pasc., from Queensland. It is just possible that Pascoe, who gives Queensland (as well as New South Wales and Victoria) for its habitat, may have confused the above with that species.

PTEROHELÆUS POLITUS, n sp.

Moderately elongate-ovate; black, very nitid, oral organs, antennæ and tarsi piceous.

Head small, epistoma rounded in front, reflexed and a little sinuous at sides, limited behind by a deep curved groove; coarsely, rugosely punctate, eyes separated by a distance equal to the transverse diameter of one eye, antennæ with third joint equal to fourth and fifth combined, [apical joints wanting.] *Prothorax* 2 5 × 5·5 mm, length in middle, width at base; narrowly bordered at apex and sides, anterior angle prominent but widely rounded, sides arcuately widening from apex to base, narrowing at the acutely produced posterior angles, base sinuate; foliaceous margins wide at base, gradually narrowing to apex, with apical half strongly convex, rather widely reflexed, finely striolate; disc moderately convex (less so than in *P. nitidissimus* Pasc), central line lævigate at base only, without distinct foveæ at base, finely and closely punctate. *Elytra*, 3 × 5·8 mm., humeral angles distinct and obtuse, slightly wider than prothorax at base, subparallel margins moderately wide on basal half, suddenly narrowing but continuous to apex, extreme border finely reflexed. Disc convex, very finely and irregularly punctate, with a few regular series of equal round punctures somewhat obscured by the confused irregular system, punctures larger and irregular in the lateral regions, extremely fine and subobsolete at base. *Prosternum* rather coarsely granulose, central carina sharp and strongly raised, abdomen finely striolate, with apical segments minutely punctate. *Dimensions*, 10·2 × 5·8 mm.

Hab.—West Australia.

A single specimen, sent by Mr. C. French, sex doubtful, is before me. The species is evidently nearest to *P. nitidissimus* Pasc., in size, and general facies, but differs from that species in (1) the much finer and more confused punctuation of the elytra; (2) more reflexed prothorax; (3) narrower apical margins of elytra; and thus is placed under a different Sub-Section in the tabulation.

PTEROHELÆUS SUBPUNCTATUS, n.sp.

Oval, black, opaque above, nitid-black beneath, antennæ piceous with apex ferruginous, tarsi and tibiæ clothed with light castaneous pile.

Head rounded and slightly raised in front of epistoma, with a well marked circular grove limiting epistoma behind, canthus raised and round; eyes large, transverse, and separated by a space of the width of the diameter of one, with very shallow, scarcely evident punctures on front; antennæ just reaching base of prothorax, with four apical joints subclavate and flattened. *Prothorax* 4 × 75 mm., length measured in middle; arcuate-emarginate at apex, widest at base, sides very slightly rounded and converging from base to apex, inflected at hind angles; anterior angles widely rounded, but produced in front of eyes; posterior angles acute, but rounded at tips and slightly produced backwards, foliate margins strongly reflected, with extreme border thickened and shining, central line distinctly shown, disc apparently quite impunctate. *Scutellum* equiangularly triangular. *Elytra* convex, slightly wider than prothorax at base, shoulders widely rounded, sides subparallel, but a little widened behind middle, margins of nearly uniform width throughout and horizontal; the two together about 1 mm. wide, extreme border a little raised and shining. Disc with seventeen rows, on each elytron, of shallow, fine (but not minute), rather distant and half-concealed punctures, the rows and punctures confused near scutellum, and obliterated at apex, intervals quite smooth and of uniform width; the outside row of large punctures more evident than usual (possibly by contrast). Abdomen finely and closely punctured near base and centre, quite smooth at sides and on epipleuræ; prosternum with strongly impressed, sinuate, longitudinal striæ, becoming fainter towards centre, tibial spines minute, femora smooth, tibiæ strongly punctured, and with a strong line of castaneous tomentum on inside. *Dimensions*, 15 × 9 mm.

Hab.—Sandstone and Whitlock, West Australia (Tarcoola, S. Australia ?).

A single specimen (♂), has been sent by Mr. C. H. J. Clayton of the Sandstone Development Gold Mine. The remains of a second specimen (♂) have been received from Whitlock; while a third, rather smaller, but, I believe, the same species has been received from Tarcoola, through Mr. C. French Its nearest ally is *P. convexiusculus* Macl., to which it is very similar in shape and outline, and convexity, but differs in its obscure elytral sculpture. The strong prosternal striæ should be a good character for identification, in a section that has few enough marked characters for a literary diagnosis. Type in the author's Coll.

PTEROHELÆUS SUBLÆVIS, n.sp.

Oval, black, subopaque above, subnitid-black beneath, antennæ piceous, with three apical joints ferruginous.

Head evenly round in front, little raised anteriorly or at canthus, depressed but without definite line to limit epistoma behind, eyes smaller and more distant than in preceding, antennæ finer and with the four apical joints rounded but less enlarged than in the preceding species. *Prothorax*, 4 × 8 mm., length measured in middle; very similar to the preceding, but anterior angles less, and sides more widely rounded, central line scarcely indicated, and with the head showing no signs of true punctures. Margins wider and more horizontal, extreme border thinner, minutely serrate at base. *Elytra* convex, of same width as prothorax at base, shoulders less widely rounded, margins slightly wider and more concave for the greater part, more narrowed at the apex. The whole entirely impunctate except for a faint extra-scutellary line of small punctures, the marginal row of large punctures (much smaller than in *P. subpunctatus*) and a few interrupted lines of scarcely evident punctures on the sides. The places usually occupied by lines of punctures faintly indicated by indistinct and indefinite striæ. *Abdomen* longitudinally and rather strongly strigose, with the two apical segments finely and closely punctured. Prosternum rugose. [Medial and hind legs wanting.] *Dimensions*, 15·5 × 9 mm.

Hab.—Yalgoo, West Australia.

A single specimen (♀), sent by Mr. C. French, presents many features in common with the preceding species, *P. subpunctatus*, and may possibly prove to be the female of that species. Its almost impunctate upper surface is, however, in strong contrast to the definite, but obscured sculpture of that species with which I have compared it above. Type in the author's Coll.

Var. A.—A second specimen (♂) differs in having more definite series, as well as some irregular punctures, on basal half of elytra, the apical half being quite impunctate.

ENCARA CAMELUS, n.sp.

Ovate, very convex, reddish-brown, nitid (when abraded), covered with a fine, waxy, whitish, bloom (when fresh).

Head: epistoma truncate, sides obliquely rounded, widened and strongly raised at canthus, narrowing at the eyes (these large and separated by a distance less than the diameter of one of them), surface rather flat, with a wide depression on each side of epistoma, and rounded transverse ridges in front of eyes: finely punctate throughout: antennæ long, slender, joints 1-6 somewhat cylindrical, 7-8 obconic, eighth wider than seventh, 9-10 widely rounded and flattened, eleventh largest, oval. *Prothorax* 4 × 11 mm., length measured in the middle; enclosing the head beyond the eyes, widest at base; anterior angles rounded but subrectangular, sides a little sinuate anteriorly, widely rounded and diverging to base: posterior angles acute, slightly falcate and directed inwards and downwards; base sinuate, finely serrated at margins, foliate margins very wide (width of combined margins to disc as 4:5), generally horizontal, with border reflexed: disc with central line depressed in front, subcarinate at base, faintly gibbous on each side, and, together with the margins, uniformly punctate in two ways, (1) a regular system of larger punctures not closely placed, (2) a minute and close system of punctures between those of system (1). *Scutellum* large and shield-shaped, punctured and subcarinate in the middle. *Elytra* as wide as long (13 mm.), of same width as prothorax at base, shoulders defined and obtuse, sides widening to half-way, then narrowing and rounded at apex; foliaceous sides wide at base, narrowing at apex, the sutural outline (seen sideways) extremely gibbous, basal and lateral declivities steep, apical declivity more gradual, surface coarsely and closely punctate, intervals rugose and nitid (after removal of bloom), with faint indications of two or three subobsolete costæ on each elytron, the suture strongly carinate, an uneven transverse ridge extending obliquely backwards from shoulder (of discal portion) to near the suture, and a slight protrusion near the apparent termination of a costa on the apical declivity. *Abdomen* very nitid and minutely punctate, prosternum opaque and rough, sharply carinate throughout, its process nearly rectangular, mesosternum with a clearly defined triangular recess; femora smooth, tibiæ slightly rough, and apparently without terminal spines, basal joint of hind tarsi as long as the rest combined. *Dimensions*, 18 × 13 mm.

Hab.—Berowra, North Sydney.

Three specimens are under examination, one taken by the late Dr. C. D. Clark, labelled N. Sydney, the other two taken by Dr. E. W. Ferguson and myself, at Berowra (one, dead, from a spider's web: the other, alive, under a stone). It differs very markedly from its nearest allies *E. submaculatum* Br., and *E. Westwoodi* Boisd., (between which it is intermediate in size), by its unusually gibbous outline, which is the same in all three specimens. The elytral punctures (seen after the removal of the waxy secretion) are coarser, while the costæ are less evident than in either of the above species. Type in author's Coll.

The following table serves for identification:—

Table of *Encara*.

Colour testaceous-brown.

1. Size large, 20-22 mm. long, three elytral costæ distinct, punctures small, maximum vertical height 4 mm.... * *Westwoodi* Boisd., *gibbosum* Westw.
2. Form very gibbous, three elytral costæ indistinct, punctures coarse (18 mm. long), maximum vertical height 4·5 mm..... ....*camelus*, n.sp.
3. Smaller (13-15 mm. long), three costæ distinct, punctures smaller, maximum vertical height 3·75 mm........ ....†*submaculatum* Brême.
4. Size less than 3 (11-12 mm. long), colour paler, one costa strongly raised and crooked, margins narrower than 3... . .. .‡*Lacordairei* Macl.
5. Covered with fungoid flocculence ....*floccosum* Pasc.
6. Colour black, three costæ on each elytron . ...*nigrum* Cart.
7. Colour chestnut-brown, margins very wide, six costæ on each elytron.... ...*latum* Cart.

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* The *habitat* of *E. Westwoodi* is South Queensland. I have specimens from Brisbane, taken by Mr. R. Illidge.

† Widely distributed throughout New South Wales.

‡ Macleay considered that the figure given by Lacordaire as *E. submaculatum*, was really that of *E. Lacordairei*. The figure given by De Brême, in his "Monograph des Cossyphides," is certainly that of the common *E. submaculatum*.

SYMPETES DENTICEPS, n.sp.

Oval, depressed, moderately nitid, glabrous, discal portion above and below, with borders of foliate margins brown, foliate margins of prothorax and elytra yellow, antennæ and legs piceous-red, tarsi paler.

Head widely truncate and flat in front, labrum just evident, epistoma limited behind by a slight transverse depression, sides almost straight, rather widely raised, and terminated at anterior angles in a distinct rectangular tooth, surface minutely granulose; antennæ stout, extending beyond base of prothorax, joints 8-10 little wider than the preceding, rounded, eleventh oval. *Prothorax*, 2 × 7 mm., length measured in middle, width at base; depressed, squarely and widely emarginate at apex, sinuate at base, anterior angles sharply rectangular, extending to the full length of head, margins very wide and flat, sides strongly diverging in a regular curve from apex to base, extreme border reflexed, thin and laminate, continuous throughout except at base of disc; posterior angles acute, produced backwards and slightly incurved at the tip; foliate margins closely and strongly punctate, above and below; disc carinate in middle, slightly gibbous near base, otherwise strongly depressed and minutely punctate. Scutellum transversely triangular and minutely punctate. *Elytra* 9 × 8 mm., disc to combined margins as 9:7, narrower than prothorax at base, shoulders obtusely angulate, sides very gradually widening to apical third, widely rounded at apex; extreme border finely reflexed and vertical (seen sideways convex, and wider than that of prothorax) foliate margins wide, in general horizontal but undulate, and forming slight three-fold gibbosities. Disc strongly carinate at suture; more convex than pronotum, with three nearly equidistant costæ on each elytron, the first two more strongly marked and continuous to the base, the third only evident posteriorly, the whole surface dotted with round punctures, intervals slightly rugose. *Prosternum* non-carinate, and with metasternum minutely and closely punctate, legs without tomentum, femora punctate, tibiæ rough. [Abdomen wanting.] *Dimensions*, 11 × 8 mm.

Hab.—Shark Bay, West Australia.

A single specimen, sent by Mr. C. French, without abdomen but otherwise perfect, is under examination. It is thus impossible to determine the sex. It is quite distinct from the thirteen species tabulated in my revision of the genus (These Proceedings, 1910, p.88), and is the smallest yet described. In form, it is nearest to *S. testudineus* Hope, while in colour it is most like *S. bicolor* Carter. The dentate sides of the epistoma present the appearance of a rectangular excision from the anterior corners, and are even more strongly marked than in *S. excisifrons* Carter. The dark colour of the disc is extended around the apical, basal, and lateral margins of the pronotum.

HELÆUS HAMLYNI, n.sp.

Oblong, subparallel, opaque, rusty-brown, densely clothed above and below with squamose derm, tarsi and basal joints of antennæ reddish.

Head: epistoma rounded in front, labrum produced, forehead depressed, eyes oblique and oval, separated by a space less than the minor axis of one eye; antennæ shorter than prothorax, third joint as long as fourth and fifth together, 4-7 increasing in width, 8-11 much wider and rounded, eleventh globular. *Prothorax* 5 × 8 mm., widest at base, thence regularly rounded to apex, anterior processes pointed and overlapping, not furrowed in middle, posterior angle acute (about 80°) very little produced; base with central lobe produced backwards, foliaceous sides wide, slightly deflected posteriorly, finely serrated on hind margin, lateral margin undefined. Disc very convex, evenly carinate in a single curve, the carina extending to apex but not to base. *Elytra* 9 × 8 mm., of same width at base as prothorax, shoulders obtuse and subdentate, sides parallel till near apex, border irregularly crenulate, explanate margin flat and of nearly equal width to apex, except for a

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short widened anterior portion; *bicostate*, each elytron with a single black shining costa extending to base and terminated on apical declivity, these costæ subparallel for the greater part, very little converging apically and about 3 mm. apart; the suture slightly costate at apical declivity only, a subcostate interval near margin of disc; sculpture of disc concealed by squamose derm; abdomen and legs covered with brown decumbent hair, sternum clothed like upper surface, prosternum sharply convex, its process produced into a blunt triangular point; fore tibiæ with a single prominent spine at apex, other tibiæ shortly bispinose. *Dimensions*, 14 x 8 mm.

Hab.—Alice River, Barcaldine, Queensland. (K. Broadbent; November, 1887).

A single specimen, labelled as above, has been sent, amongst other Tenebrionidæ, for identification, from the Queensland Museum, by Dr. Hamlyn-Harris, to whom I have much pleasure in dedicating it. A close ally of *H. crenatipennis* mihi, it differs in the following particulars from that species. Eyes more oblique; squamose clothing more dense; prothorax more convex, its outline (seen sideways) evenly curved; *elytra bicostate*, with sides less evenly and strongly crenulate. Type in Queensland Museum.

Table of *Saragus*.

Section i. Elytra costate.

A. Species with bicostate elytra.

1.(5)Colour brown.

2.(4)Size large, 20 mm. long.

3.Form elongate, parallel, prothorax very convex, granulose .... *convexicollis* Macl.

4.Form elongate-obovate, prothorax with two raised pustules...*incisus* Pasc.

5.Size small, 13 mm. long, form nearly circular. . . . .*Mastersi* Cart.

6.(8)Colour black, nitid, lateral margins of prothorax reflexed.

7.Size large, 20-22 mm. long..*Blackburni* Macl.

8.Size smaller, 15½-17 mm. long........... ....*montanus* Cart.

9.Colour black, opaque; lateral margins of prothorax not reflexed........... ....* *addendus* Blackb.

B. Species with tricostate elytra.

10.(26)Intervals of elytra rugose and tuberculate.

11.Pronotum rugose... ....*lævicollis* Germ.

12.(26)Pronotum granulose.

*** Species identified only from description.**

13.(15)Costæ uninterrupted for the greater part.
14.Elytra ovate..*rudis* Macl.
15.Elytra parallel...*lugubris* Lea.
16.(26)Costæ generally interrupted.
17.Colour uniform brown, margins of pronotum not wrinkled.................
..........*catenulatus* Macl.
18.Bicolorous, head and thorax much darker than elytra ..*inæqualis* Blackb.
19.(33)Colour black.
20.(22)Margins of elytra wide.
21.Suture elevated at apex...*Lindi* Blackb.
22.Suture not elevated...*Odewahni* Pasc.
23.Margins of elytra narrow (without the usual row of tubercles bordering the suture)..**mediocris* Blackb.
24.(26)Elytra scarcely costate, (costæ mere rows of tubercles).
25.Form hemispherical (12 × 9 mm.)...*latus* Blackb.
26.Form elongate-ovate (8½ × 6 mm.)..*levicostatus* Macl.,(?)*interruptus* Brême.
27(33)Intervals of elytra (and pronotum) punctate.
28.(30)Punctures on elytra not in rows.
29.Disc of pronotum closely and finely rugose-punctate...*emarginatus* Guér.
....*cassidoides* Boisd.
30.Disc of pronotum clearly punctate, not rugose. ....*infelix* Pasc.
31.(33)Punctures on elytra in rows, sides subparallel.
32.Size large, 16½ × 10 mm........................... *bicarinatus* Champ.
33.Size smaller, 12 × 7½ mm..................................... *tricarinatus* Blackb.

C. Species with 4 (or more) costæ on the elytra.

34.(36)Suture not costate, colour black.
35.Surface of elytra granulose...*confirmatus* Pasc.
36.Surface of elytra subobsoletely punctate.........................*opacipennis* Macl.
37.Suture strongly costate, colour brown.......................*novemcostatus*, n.sp.

The following species are unknown to me, and have been, therefore, omitted from my Table, as unidentifiable from description.

S. rugosus Boisd.—Mr. Blackburn has apparently attached this name to a small Victorian species (These Proceedings, 1889, p. 1269), but the name has been similarly attached, in some Collections, to a species from New South Wales (which I have from Bathurst); in both cases without any reason, beyond the fact that the few lines of description fit the insect; but there is no evidence, at present, to distinguish it from the common *S. lævicollis* Germ.

S. marginellus Hope.—A large tricostate species, with large flat margins to pronotum and elytra, from Norfolk Sound, apparently near *S. catenulatus* Macl.

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* Species identified only from description.

**S. marginatus* Sol.—I have neither seen the description, nor any identified specimen of this.

Notes on the Species in the Table.

The species of this group are very difficult to separate by literary means, and it is doubtful whether many of them should not be considered as varieties only. For example, *S. Lindi* Blackb., *S. mediocris* Blackb., *S. Odewahni* Pasc., differ only in characters of size, and small points of structure or sculpture that might well occur in the same species, so far as I am able to judge without a close examination of the types.

S. latus Blackb.—A very distinct species, which I have from Sea Lake, Victoria; form very globular, and with the costæ almost entirely broken up into nodules.

The synonymy of *S. levicostatus* Macl., with *S. interruptus* Brême, is extremely probable from De Brême's description and figure. I have cotypes of *S. levicostatus* Macl.

S. cassidoides Boisd. = *S. emarginatus* Guér., a synonymy given in the Munich Catalogue, but I have not met with the authority for this. It is a relief to be rid of any Boisduvallian species.

S. infelix Pasc., though near, is quite distinct from *S. emarginatus* Guér. The latter has a wide range, and is common at the roots of plants near the ocean at Sydney, but is found in all the Southern States to West Australia. *S. infelix* Pasc., from Tasmania (Mr. Lea has recorded it, and has sent me specimens from, King Island, Tasmania) is very distinct in the sculpture of its prothorax.

S. bicarinatus Champ.—I believe I have correctly identified two specimens under this name, from Camoweal, North Queensland, and Tennent's Creek, South Australia, respectively. They correspond with the figure and description. The name, however, is misleading, as the three costæ on each elytron are quite distinct.

S. tricarinatus Blackb.—Specimens from Condon, West Australia, agree with the description exactly. These specimens, however, were sent by Mr. H. Giles, in company with undoubted specimens of *S. opacipennis*, from which it differs in shape, and in the absence of the fourth costa (on the sides). The latter is often subobsolete in *S. opacipennis*, so that the two species are very closely allied, if not merely varietal forms.

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* **Postcript (added July 29th, 1911)—A copy of M. Solier's description has been courteously sent to me by Herr Gebien. From this, I have no hesitation in placing *S. marginatus* Sol., as a synonym of *S. brunnipes* Boisd.**

Section ii. Elytra reticulate.

38. (40) Elytra with reticulation clear (*i.e.*, transverse lines evident in general.)
39. Pronotum granular, elytral costæ sharp, reticulation less regular. ....*reticulatus* Haag-Rut.
40. Pronotum punctate, elytral costæ smooth and flat, reticulation very regular.. ......*intricatus* Champ.
41. (47) Elytra with reticulation obscure (*i.e.*, transverse lines generally wanting).
42. (46) Suture not raised.
43. (45) Elytral intervals granular.
44. Pronotum punctate, elytral intervals strongly undulate........................ ....*luridus* Haag-Rut.
45. Pronotum more densely punctate, elytral intervals less undulate........... ....*crenulatus* Macl.
46. Elytral intervals rugose-punctate.............................. *clathratus* Macl.
47. Suture costate, margins of pronotum thickly folded. . *rugosipennis* Macl.

The above are all quite distinct species, with the exception of *S. luridus* Haag-Rut., and *S. crenulatus* Macl., which may prove to be merely varieties of the same species.

Section iii. Elytra punctate or smooth.

48. (56) Elytra very minutely punctate.
49. (51) Species semi-apterous.
50. Elytra wider than prothorax at base, size 18·22 × 13·14 mm. *magister* Pasc.
***Icarus* Cart.**
51. Elytra narrower than prothorax at base, size 16 × 9½ mm...*Darwini* Lea.
52. (86) Species apterous.
53. (55) Suture not raised.
54. Form widely ovate and convex, margins declivous, sternum granulose.. ....*Pascoei* Macl.
55. Form elongate and depressed, margins widely raised, sternum *not* granulose..*ovalis* Macl.
56. Suture raised on apical half.. *carinatus* Brême.
57. (61) Pronotum and elytra smooth (without evident punctures).
58. (60) Colour nitid black.
59. Form elongate-ovate, subparallel, 17 × 9½ mm............ *perlævis*, n.sp.
60. Form widely ovate, 16 × 10 mm......................................*lævis* Macl.

61. Colour subopaque black, more depressed than 60... ...... *latipes*, n.sp.
62. (86) Elytra lineate-punctate.
63. (75) Intervals more or less costate.
64. (68) Costæ sharply raised, punctures on intervals large.
65. Pronotum not evidently punctate.................. *striatipennis* Macl.
66. (68) Pronotum evidently punctate.
67. Margins of pronotum strongly raised, medial line indicated.......................*geminatus* Macl.
68. Margins of pronotum horizontal, medial line not indicated..*limbatus* Pasc.
69. (75) Costæ scarcely raised, punctures on intervals smaller.
70. Margins of pronotum strongly raised...*asperipes* Pasc.;(?) *tarsalis* Hope.
71. (75) Margins of pronotum scarcely raised (or flat).
72. (74) Punctures on elytra very distinct.
73. Basal joint of hind tarsi as long as the rest combined... *satelles* Blackb.
74. Basal joint of hind tarsi much shorter than the rest combined.............. *australis* Boisd.
75. Punctures on elytra very small and less regular.......................... *simplex* Hope; *asidoides* Pasc.
76. (83) Intervals of elytra not costate, form elongate-ovate, margins of pronotum and elytra narrow.
77. Punctures on elytra coarse, intervals rugose, size 16 mm. long.................. *gulielmi* Oll.
78. Punctures on elytra much finer, intervals not rugose, size 11 mm. long.... ..... *exulans* Pasc.
79. (83) Form widely ovate, size small (less than 12 mm. long.).
80. Margins of elytra subobsolete, colour opaque black...... *illateralis*, n.sp.
81. (86) Margins of elytra normal, colour nitid brown-black.
82. Disc of pronotum coarsely punctate ....*sphæroides*, n.sp.
83. Disc of pronotum very finely punctate... ....*Frenchi* Cart.
84. (86) Form less widely ovate, some elytral intervals convex[†].
85. Pronotum minutely punctured..... *brunnipes* Boisd.; *brunnipennis* Macl. } *marginatus* Sol.
86. Pronotum more strongly punctured........................[*]*Macleayi* Blackb.

Synonymy. The synonymy of *S. magister* Pasc., with *S. Icarus* Cart., has already been fully discussed (These Proceedings, 1910, p.81).

S. asperipes Pasc. = *S. tarsalis* Hope (?).—I have doubtfully placed these together, their descriptions affording no evidence for separating them.

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[*] Species unknown to the author, but identifiable by description.

[†] Though Macleay says of *S. brunnipennis*, "interstices not raised," there are, in general, one or two subcostate intervals.

S. onidoides Pasc. = *S. simplex* Hope.—Pascoe himself stated this synonymy, which Macleay denies; but I have not seen any insect identified by Macleay as Hope's insect, and there seems every reason to accept Pascoe's opinion.

S. brunnipennis Macl., = *S. marginatus* Sol., = *S. brunnipes* Boisd.—The type of Macleay's insect agrees with De Brême's redescription of *S. brunnipes* except as to dimensions, Macleay giving 4½ × 2½ lines for *S. brunnipennis* and De Brême 11 × 7 mm. for *S. brunnipes*. I have, however, two undoubted specimens of Macleay's species, which measure 10 × 6 mm., and this very common insect may well vary to the above extent in size. The species identified by Macleay as *S. brunnipes* is widely different from Boisduval's insect, and is the species described below as *S. sphæroides*.

SARAGUS NOVEM-COSTATUS, n.sp.

Widely elongate-ovate, convex, subparallel, the whole surface opaque, chocolate-brown, and, except the discal portion of prothorax, covered with short yellowish pilose derm.

Head with labrum strongly produced, epistoma truncate with rounded angles, canthus raised, round, and forming an obtuse angle with the sides of the epistoma, the latter limited posteriorly by a semicircular groove, forehead with a distinct longitudinal sulcus widening anteriorly, closely punctured; eyes narrow, transverse, and widely separated, antennæ stout and rope-like, third joint as long as the fourth and fifth combined, the three penultimate joints round, apical joint pointed at extremity. *Prothorax* (4·4 × 10 mm ; length measured in middle, width at base) twice as wide at base as at apex, emarginate in front, with apex produced backwards at the centre in a sinuate V-curve, sides converging but curvilinear from base to apex, margins wide and strongly reflexed on front half, anterior angles slightly rounded, posterior angles acute and deflexed, base trisinuate, extreme border raised at apex, thickened and slightly raised at sides, subobsolete at base; disc slightly gibbous towards base, distinctly channelled to meet the angle of V at apex, channel obsolete at base, surface coarsely and closely punctured, intervals a little rugose anteriorly. *Scutellum* widely triangular. *Elytra* as wide as prothorax at base, shoulders subangulate but rounded, sides parallel to half-way, widely rounded at apex, convexity strongly increasing posteriorly, apical declivity abrupt, margins widely horizontal at shoulders, soon narrowed and becoming deflexed apically; each elytron with the suture carinate throughout and with four strongly raised equidistant costæ, the suture less raised than the adjacent costæ; the first costæ parallel to suture, diverging at extreme base and joining the fourth costæ near apex; second and third costæ converging at base and terminating in diminishing nodules independently towards apex (the third longer than second); the fourth interrupted before half-way, then a line of more or less elongate nodules at the junction of disc with margins, the third costæ only slightly interrupted: on each side of suture and costæ are rows of large punctures; those outside the fourth costæ larger than the rest; the intervals between the costæ also irregularly impressed with smaller, shallower punctures than the preceding, and less obvious on account of the short, yellow, hairy derm on the elytra. *Abdomen* punctate and covered with a similar but shorter clothing than that on the upper surface. *Epipleuræ* nearly smooth, but with large, round, irregularly scattered punctures. *Femora* and *tibiæ* covered like the abdomen with hairy derm. *Prosternum* raised, scarcely carinate, with the produced portion received into the mesosternum in a wide U-shaped receptacle. Anterior tibiæ with a short blunt spine at apex. *Dimensions*, ♂. 17·5 × 10·5 mm.; ♀. 15 × 9.5 mm.

Hab.—North-west Australia.

Specimens of the above occur in the Macleay Museum; and two specimens have been given me by Mr. Masters. It differs markedly from all hitherto described species with costate elytra by its distinct chocolate colour, caused by the yellowish derm on a darker ground. This derm covers the whole insect, except the disc of pronotum. Its nearest ally is *S. bicarinatus* Champ., which has only three costæ on each elytron, is less convex than, and differs in colour from *S. novemcostatus*. Types in author's Coll.

SARAGUS PERLÆVIS, n.sp.

Moderately elongate and subparallel, black, nitid, smooth; oral organs, antennæ and tarsi reddish. *Head* and pronotum quite impunctate, the former widest at canthus, sides converging and sinuate to the truncate and unreflexed front of epistoma; frontal ridge slightly raised, without any separating sulcus from epistoma; antennæ with third joint about equal to fourth and fifth combined [apical joints wanting]. *Prothorax* (5 × 9·5 mm.; length in middle, width at base), width across front angles 4 mm., disc to combined margins as 7 to 9·5; apex semicircularly emarginate, anterior angles produced beyond eyes, obtuse and rounded; sides evenly rounded, incurved at the blunted but acute posterior angle, base sinuate, foliate margins wide, concave, with extreme border strongly recurved except posteriorly; disc with a very faint suggestion of a central line, two shallow foveæ near base. *Scutellum* curvilinear-triangular. *Elytra* as wide as prothorax at base, sides parallel for half their length, widely rounded at apex, shoulders obtuse, foliate margins wide and horizontal, narrowed to about half their width at apex, extreme border raised; disc slightly depressed behind scutellum, quite smooth except for a lateral row of close, rather small, shallow punctures, and a faint longitudinal stria a little above this row. Prosternum sharply convex, not carinate, produced posteriorly into a blunt tooth, received into a wide triangular receptacle in the mesosteruum; sternum faintly granulose, basal segments of abdomen closely strigose. Apical segment minutely punctate and bordered a red colour; anterior tibiæ rough, their apical spurs unusually small, all femora smooth and nitid, and red at the knees. *Dimensions*: 17 × 9·5 mm.

Hab.—Carnarvon, West Australia.

A single specimen, female, in the National Museum, Melbourne, differs from its nearest ally, *S. lævis* Macl., by its elongate, subparallel form, its much narrower border to pronotum, and the elytra without any indication of raised lines, head not reflected in front, &c. From *S. simplex* Hope, (= *S. asidoides* Pasc.), it differs even more markedly in shape, and the even surface of its elytra.

My specimens of *S. lævis* Macl., compared with type, were taken at Birchip, Victoria, by Mr. J. C. Goudie. Macleay's habitat is "interior of New South Wales."

SARAGUS LATIPES, n.sp.

Ovate, depressed, subopaque black above, margins of pronotum and elytra reddish, nitid black beneath; oral organs, antennæ, and upper surface of tarsi black, the last clothed beneath with red tomentum.

♂. Head, with labrum strongly emarginate, epistoma truncate in front, angles rounded, their border reflexed at sides, limited behind by oblique raised lines; forehead rather flat, antennæ slender, not extending to base of prothorax, third joint little longer than fourth, joints 8-11 much widened, ninth and tenth rounded, eleventh ovoid. *Prothorax* (4 × 8·5 mm.), length measured in middle, width at base, disc is to combined margins as 5 to 8·5; apex semicircularly emarginate, anterior angles rounded but very prominent, sides evenly rounded to the strongly produced acute posterior angles, and not, or scarcely, incurved in this region, foliate margins wide, nearly flat, without separating sulcus, extreme border thickened and raised on sides, becoming narrow at apex and obsolete at base, the latter strongly sinuate: disc, like the head, quite impunctate, without any indication of a central line, with two faint foveæ near base. *Scutellum* transversely triangular. *Elytra* slightly wider than prothorax at base, obovate, humeri defined and obtuse, sides gradually narrowing from base towards apex, foliate margins wide, also narrowing (but still wide) at apex, extreme border very thin and reflexed, lateral row of punctures large and close anteriorly, smaller, more distant, posteriorly obsolete at apex; placed in a distinct sulcus, with a faintly impressed short row of small punctures close to and above the former row; disc quite smooth and impunctate, with the faintest suggestion of raised longitudinal lines (only visible in strong light). Prosternum rather flat and apparently quite smooth, its apical process narrow, blunted and received into a narrow triangular receptacle of the mesosternum; basal segments of abdomen faintly strigose, apical segments impunctate, femora smooth, anterior tarsi scabrous, with the three basal joints unusually widened, in strong distinction to the small fourth joint.

♀. Differs only in the slightly wider and less obovate elytra, and in the normal anterior tarsi. *Dimensions:* ♂. 13 × 9 mm.; ♀. 14 × 9 5 mm.

Hab.—Bell, South Queensland.

Two specimens, taken by Mr. Horace Brown, and generously given to me; also specimens in the National Museum, Melbourne, differ from *S. perlævis* (above) in colour especially of antennæ and tarsi, in their shorter and more oval and depressed shape, in the less recurved margins of pronotum, the proportionally wider elytral margins, the subobsolete costæ on disc, &c. Types in author's Coll.

From *S. lævis* Macl., this species differs in its opaque colour, smaller and more depressed form, its obovate elytra, (those of *S. lævis* being evidently widest behind the base), the much less thickened extreme border to pronotum and elytra, the wider margins of elytra (especially at apex), the colour of antennæ and tarsi, and the strongly marked sexual character of the latter. This last character is more marked than in any Saragus I have examined.

SARAGUS ILLATERALIS, n.sp.

Widely oval, very convex, opaque black above, nitid piceous-black beneath; palpi, antennæ, and legs piceous-red, tarsi clad with pale golden hair.

Head with labrum emarginate, epistoma semicircular and a little concave in front, border slightly thickened and reflexed, sinuate in front of the canthus, the latter raised and ear-like, limiting suture well marked at sides, widened behind, with a distinct fovea on each side, the whole head closely and rather coarsely punctate; eyes large, and separated by a space about once and a half the transverse diameter of one eye; antennæ stout and short (not reaching base of prothorax), third joint scarcely equal to the two succeeding, apical four successively wider and flattened, apical joint nearly semicircular. *Prothorax*, 3 × 7 mm., length measured in middle, greatest width at base, width across anterior angles 4 mm.; apex very convex, and base subtruncate at middle, anterior angles feebly emarginate, rounded, and widely obtuse; sides widening in a slight curve from apex to base, then rather abruptly incurved (not sinuate) and upturned at the subacute falcate posterior angle; foliate margin wide, nearly flat and sloping obliquely downwards, without lateral gutter, extreme border nitid, thin, scarcely reflexed; wider than and overlapping elytra at base, hinder portion of margin much produced backward; disc finely, closely punctate, central line distinctly shown by a lævigate impression, a transverse depression near base emphasising the convexity. Scutellum less transverse than usual, triangular and closely and evidently punctate. *Elytra* widely ovate, length equal to width (8 mm.), greatest width behind middle, very convex, with the greatest height (looking sideways) behind middle; margins very narrow, flat, and reddish, but evident, when viewed from above, throughout, slightly widest near shoulders, these widely rounded; extreme border thin, not channelled within and scarcely reflexed; disc with about seventeen rows of half-concealed, subobsolete punctures, the rows a little irregular and obscure in places, besides a short scutellary row of similar punctures, the lateral row slightly larger, only clearly traceable on basal half; between each four rows of punctures is a subobsolete costate interval, the suture slightly depressed behind scutellum, the suture and all intervals almost microscopically, closely punctate. *Submentum* coarsely and closely punctate, prosternum rather flat and granulose, its episterna with deeply impressed curved striæ, prosternal process bordered by a raised line produced backwards into a triangular receptacle of the mesosternum; basal segment of abdomen coarsely, other segments and legs very finely punctate, epipleuræ smooth, tibiæ sparsely clothed with short bristles, without a tomentose line; and armed at apex with a short acute spine. *Dimensions* 11 × 7 mm.

Hab.—North Queensland.

Two specimens, both apparently female, are before me; one labelled Etheridge, Q., from Mr. C. French; the other from Mr. Dodd of Kuranda. Most nearly allied to *S. sphæroides* (infra), but more elongate, and with much narrower elytral margins. Without a lens, the whole upper surface appears smooth, but the striæ and punctures are quite evident when magnified (× 10). The structure of the antennæ and sternum shows an affinity with *Onosterrhus*. Type in the author's Coll.

SARAGUS SPHÆROIDES, n.sp.

Widely ovate, very convex, black or brown-black, moderately nitid above, black or piceous-red beneath, antennæ, oral organs and tarsi red.

Head coarsely and closely rugose-punctate, epistoma sinuate in front (incurving at the middle), reflexed at margins, limiting suture deeply impressed, antennæ short, joints 7-10 much wider than long, cup-shaped, eleventh oval. *Prothorax* 3 × 8·5 mm., length measured in middle, widest at base, combined margins at base about half the width of disc, anterior angles obtuse, sides widely rounded and diverging to base, scarcely sinuate, posterior angles produced, acute and slightly falcate, base sinuate, foliate margins wide, reflexed at extreme border, finely strigose-punctate, disc convex, distinctly and evenly punctured. *Elytra* (8·5 × 9 mm.), ovate, convex, of same width as prothorax at base, shoulders defined and obtuse, sides gradually widening to middle, widely rounded at apex, margins scarcely foliaceous, partly declivous, narrowly horizontal, wider at base, the horizontal portion of uniform width throughout, disc lineate-punctate, with about seventeen rows of almost uniformly placed punctures, with some additional scattered punctures near the sides, the seventeenth row (on sides) containing much larger punctures, intervals and margins minutely and closely punctate, intervals scarcely at all convex, suture not raised. Abdomen and femora strongly punctate, tibiæ rugose, apical spur long and robust, prosternum very rugose, carinate in middle. *Dimensions*: 11-12 × 9 mm.

Hab.—West Australia: Condon (Mr. H. Giles); Shark's Bay, (from Mr. C. French).

This species has long stood in the Macleay Museum for *S. brunnipes* Boisd. It is so evidently more convex, and widely ovate, and differs in its proportions and colour from Boisduval's species, as described and figured by De Brême, that I have no hesitation in describing it as new. The elytral interstices can scarcely be said to be "faiblement relevées en côtes." Three speciments (one ♂) are under examination; the male specimen is quite black above and below; the type-female has the underside distinctly reddish, so that the margins of the pronotum and elytra show a reddish tinge from above.

PLATYCILIBE (nov. gen. Ulominarum).

Near *Acthosus* Pasc., with a facies like the European *Phthora*, but differing from the former by its shorter, broader, and more depressed form, and in the following characters. *Mandibles* denticulate at apex; *palpi* with last joint cylindrical and slightly subulate; *mentum* trapezoidal, widened and rounded in front; *antennæ* with first joint somewhat geniculate, third small, scarcely longer than fourth, 3-6 cupuliform, 8-10 transverse and trapezoidal, eleventh oval, apical four joints clavate; front tibiæ minutely spined, and widely serrated on external margin. Other characters as in *Acthosus*.

PLATYCILIBE BREVIS, n.sp. (Plate viii.).

Short, broad, depressed and parallel, nitid black above and beneath; antennæ, palpi, and tarsi piceous.

Head wide, convex on forehead, epistoma depressed, rounded in front, and limited behind by a transverse suture, immersed in the prothorax to the eyes, the latter small. Surface of head and prothorax finely, closely punctured. *Prothorax* (1·5 × 3·5 mm.), subtruncate at apex, with anterior angles subrectangular and strongly produced forward, sides a little arcuate anteriorly, then almost parallel to base; posterior angles obtuse, base truncate, with a narrow horizontal margin at sides, base and apex with evident but very narrow border, without central channel. *Scutellum* round, with a central puncture. Elytra closely fitting prothorax, and of same width at base; sides subparallel, apex bluntly rounded, striate-punctate, with nine striæ on each elytron (three of these on the sides), striæ filled by close, rather large punctures, intervals a little convex, especially near sides, and apparently impunctate. Under surface finely punctate, prosternum convex, legs short, intermediate and posterior tibiæ very thin, fore tibiæ a little expanded at apex, all tibiæ minutely spined at apex, posterior intercoxal process triangular. *Dimensions*: 4·5 × 2·8 mm.

Hab.—Blue Mountains, New South Wales; and Victoria (?).

Several specimens were taken by the author and Dr. E. W. Ferguson at Mount Wilson, under bark of rotting Eucalyptus logs. I have since taken individual specimens at Medlow (Blue Mountains), and one specimen has been sent to me by Mr. C. French (without locality-label), probably from Victoria. It is readily distinguished from *Acthosus* by its broad, depressed form, and apparently undenticulate tibiæ. The microscope, however, shows minute spines. One specimen is undoubtedly male, but I cannot detect any decided sexual characters in the structure.

I am indebted to Mr. F. A. Taylor, of the Technological Museum, Sydney, for the micro-photographs reproduced in Plate viii.

Note.—In *Acthosus laticornis* Pasc., the apical joints of the maxillary palpi are securiform; in *A. Westwoodi* Pasc., they are distinctly oval, though Pascoe says "shortly triangular" (Journ. of Ent. 1863, p.43). *A. insularis* Lea, from King Island, Tasmania, is, I consider, a species distinct from *A. Westwoodi* Pasc., from which it differs in the following particulars; epistomal lobe vertical, (in *A. Westwoodi* horizontal, reflexed only at angles), antennæ much wider and coarser, elytral intervals on disc quite flat, slightly convex on sides, (in *A. Westwoodi*, all convex), prosternum coarsely transversely wrinkled and punctate (in *A. Westwoodi* punctate only), size much larger, 21 × 8 mm., (the largest *A. Westwoodi* I have, is 18 × 6·5 mm).

BRACHYCILIBE (nov. gen. Ulominarum).

Facies not unlike that of *Platycilibe*, in proportion of length to breadth, but much more convex. *Mandibles* denticulate at apex, *palpi* as in *Platycilibe*, *mentum* narrowly trapezoidal, narrowed in front; *antennæ* with first joint not geniculate, 2-3 cupuliform and slightly thicker than succeeding, 4-8 moniliform, ninth a little transverse, tenth widely transverse and cup-shaped, eleventh largest and spherical; front and intermediate tibiæ minutely spined on external margin, and bispinose at apex, those on anterior tibiæ large and toothlike. Other characters as in *Acthosus* Pasc.

BRACHYCILIBE ANTENNATA, n.sp.

Short, broad, very convex and subparallel, brownish-black, nitid; antennæ, palpi, legs, and underside reddish. *Head* wide, immersed in thorax to eyes, these prominent and round; epistoma truncate in front, with sides sharply rounded, strongly concave above, without limiting suture; head and thorax rather coarsely and not very closely punctate. *Prothorax* (1·8 × 2·5 mm.) very convex, arcuate at apex, truncate at base, anterior angles obtuse not produced, scarcely visible from above through great convexity, sides evenly rounded, posterior angles obtuse, sides more narrowly margined than in *Platycilibe*, base and apex just perceptibly bordered. *Scutellum* very small, and round. *Elytra* short, subparallel, of same width as prothorax at base, apex bluntly rounded; punctate-striate, with six striæ above, and two on sides of each elytron, punctures not so large or so close as in *Platycilibe* (about 12 from scutellum to apical declivity), intervals smooth, and slightly convex, (this more evident in sutural and lateral intervals). Underside finely punctate, prosternum ridged, legs much stouter than in *Platycilibe*. *Dimensions*: 4·8 × 2·5 mm.

Hab.—Lord Howe Island.

There are several specimens in the Macleay Museum, collected by Mr. Masters, some years ago. At first, it seemed a close ally of *Platycilibe brevis*, but the striking differences in *antennæ*, mentum, and legs, and different form, especially of prothorax, prohibit its inclusion in the same genus. The antennæ are unlike anything I have seen amongst the Tenebrionidæ, and remind one of certain Pselaphidæ, the last two joints being much wider than the rest, and joints 3-8 being subequal. Types in author's Coll.

ALPHITOBIUS TORRIDUS, n.sp.

Elongate, parallel, convex, chestnut-brown, nitid above and beneath, legs and palpi paler. *Head* depressed and concave in front of eyes, epistoma slightly reflexed and rounded at apex, head and prothorax closely, finely punctate, eyes large and prominent, palpi with last joint subcultriform, mentum subcordate, antennæ with third joint slender and scarcely longer than fourth, succeeding joints successively wider to apex, 4-7 moniliform, 8-10 transverse, eleventh globular. *Prothorax* (2 × 3 mm.), convex, truncate at apex, with anterior angles obliquely emarginate, shortly lobate and truncate at apex, sides sinuate anteriorly, very little rounded at middle, and very slightly narrowed behind, posterior angles obtuse, base slightly sinuate, with centre a little produced backwards, sides and base with a narrowly raised margin, disc without central line or foveæ. *Elytra* about twice and one-half as long, and of the same width as prothorax, convex and parallel: striate-punctate, with eight striæ on each elytron, besides a short scutellary stria, the punctures in striæ round, small and placed at the sides of the raised intervals, the first three striæ wide and rather deep, and when seen directly from above, appearing smooth and impunctate, the intervals also minutely punctate; sternum and abdomen closely, and finely punctured; femora and tibiæ smooth. All tibiæ unarmed on margin, fore tibiæ widely trigonate, with a long stout spine on external apex. *Dimensions*: 7·5 × 3 mm.

Hab.—Cape York, North Queensland (Mr. H. Hacker).

I received three specimens from Mr. Hacker some time ago, and have, so far, hesitated as to their exact position in the family. Resembling *Acthosus* in facies, this species, having unserrated tibiæ, cannot be included in that genus; and I am unwilling to propose a new genus for so slight a character. The structure of the prothorax, with its truncate but produced anterior angles, should render it easy to identify. One specimen is obviously male, but there do not appear to be any marked sexual characters.

ASPHALUS STRIATUS n.sp.

♂. Ovate, convex, black, nitid; palpi, antennæ, and tarsi red.

Head and prothorax minutely but evidently punctate. *Prothorax* 5 × 7 mm., the sides straighter than in *A. ebeninus* Pasc., with the lateral margins of equal width throughout, posterior angles wider than in *A. ebeninus*. *Elytra* more convex than in *A. ebeninus*, with nine well marked striæ on each elytron, the ninth at the margin; intervals finely but distinctly punctate, the striæ becoming fainter at base and apex, those nearer the suture consisting of deep, elongate, almost continuous punctures; anterior femora strongly curved inwards at the apex, intermediate femora less bowed, posterior femora nearly straight.

♀. Differs only in the femora, (especially the anterior) being much less bent. *Dimensions*, 16-17 × 7 mm.

Hab.—Gympie, Queensland (Mr. R. Illidge).

Two specimens, one of each sex, were kindly given to me some time ago, by the well known Brisbane entomologist, who captured them. The species differs markedly from the common *A. ebeninus* Pasc., in (1) wider, more stunted and convex form; (2) the more evident punctures of the head, prothorax, and elytral intervals (and consequent less nitid colour); (3) the strong striation of the elytra; (4) the much greater curvature of the front tibiæ of the male (very much as in some species of *Hypaulax* or *Meneristes*). Types in the author's Coll.

Having lately taken a large number of *A. ebeninus* Pasc., in Northern New South Wales, I have been able to compare the above with these. Any one of the *four* differences noted above, would serve to separate the two species.

PLATYPHANES PUNCTIPENNIS, n.sp.

Elongate-ovate, glabrous, pronotum dull bronze-black; elytra nitid, greenish bronze-black; antennæ, oral organs, and tarsi testaceous; underside black, moderately nitid.

Head with labrum widely emarginate, epistoma flat, broad, rounded in front, raised at sides, limited behind by a straight suture with oblique depressions near epistomal angles; finely punctate, forehead flat and less visibly punctured; antennæ with third joint little longer than fourth, all joints successively wider to apex, apical four joints much wider than preceding, thirteenth oval. *Prothorax*, 3 × 5·5 mm., wider at base than at apex, greatest width at middle; apex semicircularly emarginate, anterior angles acute, produced to the eyes, sides gradually widening and parabolically raised half-way, slightly sinuately narrowing near the acute posterior angles; base strongly sinuate, with the central lobe produced backward, extreme border thickened at sides, narrow at apex, obsolete at base, foliate margins not distinguished from disc, without any lateral canal, closely, minutely punctate (punctures only visible under a lens), the medial line faintly indicated by the absence of these punctures, and by a slight depression near base, two large transverse depressions also near base, one on each side of medial line. *Scutellum* large, smooth and scutiform. *Elytra* wider than prothorax at base, and nearly four times as long, convex, shoulders rounded, sides subparallel anteriorly but slightly widening behind middle, and sharply rounded at apex; extreme border narrowly horizontal (only visible from above behind the shoulders); disc irregularly dotted with large punctures, without seriate arrangement, punctures becoming obsolete at the humeral swelling and at apex. *Prosternum* finely striolate, and carinate in middle, anterior and middle coxæ with raised borders, intermediate intercoxal process wide and rounded, posterior process widely triangular, abdomen finely, closely punctate and coarsely strigose; tibiæ slender, posterior tarsi with basal and claw-joints subequal, intermediate joints very short. *Dimensions*, 15-18 mm. long, 6·5-8 mm. wide.

Hab.—Forest Reefs (A. M. Lea), Blue Mountains, and Illawarra districts, New South Wales.

Three specimens are under examination, easily distinguished from other described species by the sculpture of the elytra.

OTRINTUS CYLINDRICUS, n.sp.

Elongate, parallel, cylindric, nitid violet-bronze; palpi and apical joints of antennæ piceous and opaque, underside nitid black.

Head: labrum very prominent, epistoma arcuate and convex, deeply impressed near sides, limiting suture clearly defined and straight, with sides forming a rectangle enclosing forehead; eyes very narrow, forehead foveate, the whole surface very minutely, not densely nor deeply punctate; antennæ stout, extending to base of prothorax, third joint shorter than fourth and fifth combined, 4-10 subequal and oval, eleventh ovate-acuminate. *Prothorax* 4 x 3·5 mm., slightly wider near apex than at base, anterior angles rounded but acute, scarcely produced or prominent, apex arcuate, sides nearly straight, sometimes faintly sinuate behind the middle, hind angles obtuse, rounded, not at all projecting, base not coarctate, margins not foliaceous, extreme border narrowly reflexed laterally, less evident at base and apex; disc deeply canaliculate, surface microscopically punctate, sometimes with a small fovea on each lobe. *Scutellum* prominent, semicircular. *Elytra* twice and one-half as long as prothorax, and slightly wider, very cylindric and convex, humeri obsolete, or barely indicated by epipleural fold; striate, with six well-marked striæ on each elytron, and three faintly impressed on sides, *interstices of disc distinctly convex*, apical segments of abdomen minutely punctate, basal segments and epipleuræ smooth, intercoxal process rounded, prosternum finely transversely strigose, mesosternum rugose, with a smooth carina in the middle, fore tibiæ curved, the other tibiæ straight; femora without sexual characters, front femora swollen. *Dimensions*, 15-18 × 4-4·5 mm.

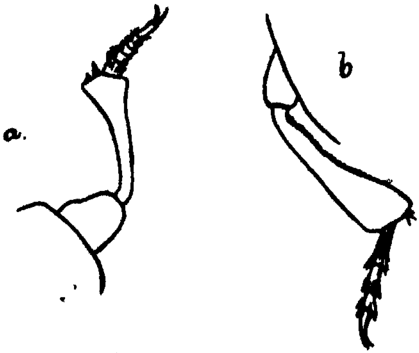
Hab.—Queensland, widely distributed, (Atherton, Toowoomba, Killarney, &c.)

I have long had this species under observation, and, in January of the present year, Mr. Sloane and I found it very common at Killarney (South Queensland). It differs from the equally common southern species, *O. Behri* Germ., in its still narrower, more convex and cylindrical form, its bronze colour, its convex elytral interstices, and narrower eyes, *inter alia.* Twenty-seven specimens under observation show little indication of sexual characters, though the male has been determined by dissection. [I have not been able to detect the armed femora of the male in *O. Behri* Germ., mentioned by Bates in his tabulation (Ent. Mo. Mag., xvi., p.30): nor is it the case that the epipleural fold is not visible at the humeri. Also in Germar's description, the words "coleoptera thorace paullo angustiora" are true of only some specimens. In general, the elytra are wider than the prothorax, and the species is wider and flatter than *O. cylindricus.* The range of *O. Behri* is very wide; I have specimens from Forbes, New South Wales, and Eucla, South Australia.]

OTRINTUS FERGUSONI, n.sp.

Elongate-ovate, bronze, very nitid; apical joints of antennæ fuscous, tarsi and tibiæ (at apex) clothed with red tomentum, underside nitid black.

♂. Head and prothorax microscopically punctate, the former with epistoma in front produced into a short, raised, semi-lobate process in the middle, limited behind by a deep suture, frontal stirrup-shaped impression well marked and foveate at base; eyes narrow and transverse, antennæ stout, extending to base of prothorax, third joint longer than fourth, 4-10 successively widening, eleventh longer but not so wide as tenth. *Prothorax* about as wide as long (3¾ mm.), widest in front of middle, much wider at apex than at base, anterior angles little produced and bluntly rounded, sides rather widely rounded and narrowed, without sinuation, at base; obtuse posterior angles not at all produced, base widely angulate, not coarctate, margins narrowly channelled within, foveate near the middle, narrowly raised at extreme border, subobsolete at base and apex; disc with medial line impressed throughout, widening into an elongate fovea near base, with a fovea on each side near posterior angles. *Scutellum* shield-shaped and punctate. *Elytra* rather more than twice as long as prothorax, and of the same width at their widest; shoulders very oblique, with epipleural fold visible from above throughout the whole length, sides gently rounded and tapering to apex; with six striæ on each elytron, intervals narrow and convex, the fourth rather wider than the rest, sides and epipleuræ quite smooth, as also the sternum and abdomen. Front and hind tibiæ curved on the inner edge (not bowed inwards), strongly enlarged into a wide lobe at apex, and lined on this inside edge with minute granules and a fringe of tomentum, the wide flange at apex of front tibiæ similarly clothed with red tomentum, that of the hind tibiæ being hollowed and minutely granulose, fore tibiæ armed



Otrintus Fergusoni, n.sp., ♂
a. Fore tibia.—b. Hind tibia.

with two spurs at apex (one very short), posterior tibiæ armed with two minute spurs.

♀. Differs from the male in having the tibiæ much less enlarged at apex, and being without apparent granulations. *Dimensions*, 13 × 3¾ mm.

Hab. – Muswellbrook, New South Wales (Dr. E. W. Ferguson).

I have named this interesting species after its discoverer, who has generously given me the only pair taken by him. The species is easily distinguished from *O. cylindricus* mihi, and *O. Behri* Germ., by its shorter, more ovate, and less cylindrical form, wider prothorax, and the marked sexual characters of the tibiæ, shown in the accompanying figure. The female specimen might well be confused with that of *Cardiothorax politicollis* Bates, but for the complete absence of foliate margins to the prothorax. The curiously produced epistoma is unlike anything I have seen in this or allied genera, showing a triangular outline when viewed from behind.

OTRINTUS ACACIENSIS, n.sp.

Elongate-ovate, rather flat, moderately nitid brownish-black; antennæ, tarsi, and tibiæ opaque piceous-brown; underside brown, tarsi and inside of tibiæ clothed with red hair.

Head: maxillary palpi very long, apical joint darker than the preceding joints, labrum very prominent, epistoma rounded and widely convex, limiting suture deeply impressed, curved in front, oblique at sides, foveate at the acute angles so formed, forehead with a raised stirrup-shaped impression, with one or two foveate punctures, the whole head coarsely punctate; antennæ very long and robust, extending considerably beyond base of prothorax, third joint subcylindric, not as long as the fourth and fifth combined, joints 4-10 varying gradually from obconic to ovate and gradually wider, eleventh twice as long as tenth, elongate-ovate. *Prothorax*, of ♂, 4 × 3·5 mm.; of ♀, 4 × 4 mm., length measured in middle; widest at middle, subtruncate at apex, coarctate at base, wider at apex than at base; sides not sinuate, converging lightly anteriorly, more strongly posteriorly, anterior angles round and obtuse, not prominent, margins narrowly horizontal without channel or foliation, extreme border very narrow throughout, posterior angles defined and obtuse but not dentate; disc canaliculate, medial line not extending to either margin and sometimes broken in the middle, a wide foveate impression on each side of this, the whole surface distinctly and closely punctate. *Scutellum* rounded behind and punctate. *Elytra* wider than prothorax at base, and about twice as long, shoulders rounded, epipleural fold evident, elongate-ovate, not parallel, widest behind middle, finely tapering to apex, striate, with ten striæ on each elytron (including sides), intervals convex and finely punctate, the lateral striæ showing lines of fine, close punctures, not seen on the discal striæ; without evident margin, epipleuræ rapidly narrowing and coarsely punctate. Abdomen and femora finely punctate, intercoxal process rounded, sternum convex, with fine, distant punctures, the episterna coarsely punctate; basal joint of front tarsi of male very wide, of hind tarsi long (not quite as long as the rest combined). *Dimensions*, ♂, 13 × 3·6 mm.; ♀, 15 × 4 mm.

Hab. Acacia Creek, MacPherson Range, New South Wales.

Ten specimens, taken by the author and Mr. T. G. Sloane, in January, 1911. The species belongs to the *O. Jacksoni* and *O. striatus* group, which are differentiated from *O. Behri* Germ., by their flatter and non cylindric form, the pronotum truncate at apex and truncate or coarctate at base, the evident punctures on the head and pronotum, and their longer hind tarsi. *O. acaciensis* is separated from *O. Jacksoni*, and *O. striatus* mihi, by its nitid colour, the different number of elytral striæ, and the much coarser punctuation of head and pronotum. The five described species of *Otrintus* may be tabulated as follows.

Table of *Otrintus*.

A. Form, subcylindric, base of pronotum not coarctate, head and pronotum smooth or only microscopically punctate.

1. Colour black, elytral intervals flat, tibiæ normal.................*Behri* Germ.
2. Colour black, elytral intervals convex, tibiæ of ♂ with strong sexual characters...*Fergusoni*, n.sp.
3. Colour bronze, elytral intervals convex.................*cylindricus*, n.sp.

* B. Form depressed, elongate-ovate, base of pronotum truncate or arcuate, hind tarsi longer than in A.

4.Colour opaque brown-black
5.Pronotum subcordate, elytral intervals sharp, 12-14 mm. long............... *striatus* Cart.
6.Pronotum narrower, elytral intervals rounded, 16-17 mm. long...... .... *Jacksoni* Cart.
7.Colour nitid brown-black, 13-15 mm. long.............. .... *acaciensis*, n.sp.

CARDIOTHORAX BISULCATUS, n.sp.

Elongate-ovate, bright golden-bronze, very nitid, body beneath and femora iridescent with violet and copper reflections.

Head: labrum emarginate, epistoma pointed in the middle, with a setiferous puncture on each side, frontal impression rather square, with one or two punctures near its base, the whole surface microscopically punctured; antennæ long and slender, joints 4-10 gradually enlarging and cup-shaped, eleventh ovate-acuminate. *Prothorax*, 3 × 4½ mm., length measured in middle; widest at middle, arcuate-emarginate at apex, subtruncate (or slightly non-coarctate) at base, anterior angles prominent and acute, sides evenly rounded, meeting base without dentation or sinuation at an obtuse angle, extreme border narrowly raised at sides, less evident, but existent, at base and apex, margins moderately foliaceous (as in *C. æneus* Bates), separated from disc by sulcus, and bearing two setiferous punctures on each margin; disc canaliculate throughout, a fovea on each side at base, and one or two vaguely defined foveæ on each side of central line, the whole microscopically punctate. *Scutellum* oval. *Elytra* oval, shoulders oblique and widely rounded, epipleural fold scarcely evident; disc with two deep sulci, continuous from base to apex, one on each side of the suture, and four or five vaguely defined striæ becoming obsolete towards the sides and apex, the interval between sulcus and suture convex and bearing a foveate puncture near scutellum, other intervals flat. *Epipleuræ* and underside smooth. Legs thin, fore tibiæ carinate on outside edge, slightly enlarged and shortly bispinose at apex. *Dimensions*, 11-12 x 4 mm

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* Group B will probably be found to require a new generic title.

Hab.—Dalveen, South Queensland.

Six specimens of this brilliant little species were taken by the author, in January, 1911. The sexual characters are very slight. One larger and proportionally narrower specimen, presumably male, has the hind tibiæ slightly bowed and expanded, and the basal joint of the front tarsi a little enlarged. This species belong to the *C. politicollis* Bates, section so far as the absence of a dentate hind angle to prothorax is concerned; but, in the foliaceous margins, it resembles *C. æneus* Bates; and, in colour, *C. aureus* Cart.; while the elytral sculpture is entirely different from that of any described species of the genus. The great numerical inequality of the sexes is noteworthy, females being to males as 5: 1. Of a large number of *C. femoratus* Bates, taken at Acacia Creek, a few days later, the proportion recorded was 40 females to 8 males, or again a ratio of 5 : 1.

CARDIOTHORAX LATICOLLIS, n.sp.

Elongate-ovate, violet to dark bronze, nitid, body beneath and legs nitid black, tarsi and apex of tibiæ clothed with reddish hair.

Head: labrum very prominent and strongly punctate, right mandible with apex curved, hollowed below (gouge-like), left mandible pointed, frontal impression deeply marked, with a large foveate impression on its centre, this in turn with a few small punctures, the whole surface microscopically punctate. Antennæ thick, extending to base of prothorax, joints 4-10 ovate and successively larger, eleventh elongate-ovoid. *Prothorax*, 5 x 6 mm., length measured in middle; arcuate-emarginate at apex, subtruncate (non-coarctate) at base, wider at apex than at base, widest at middle;

anterior angles widely rounded, sides evenly and widely rounded, posterior angles small, sharply acute or subrectangular, directed downwards and a little outward, foliaceous margins wide and flat, a slight sulcus separating them from disc with a few (one to three) setiferous punctures thereon, extreme border black and raised throughout, disc with medial line evenly impressed throughout, otherwise smooth or microscopically punctate. *Scutellum* cordate, on same level as elytra, smooth. *Elytra*, 10 × 6 mm., oval, shoulders rounded, epipleural fold not prominent, with eight well marked sulci on each elytron above, and two on the side, intervals equal and strongly convex (increasingly so towards the sides and apex). Epipleuræ and abdomen smooth, prosternum transversely lightly striate. Femora unarmed, fore and hind tibiæ curved, the former enlarged at apex, the latter strongly compressed and expanded throughout, grooved and asperate on the inside, all tibiæ with two long spines at apex.

♀. More robust, hind tibiæ not expanded, and all tibiæ nearly straight, front tarsi smaller. *Dimensions*, 15-18 × 5-7 mm.

Hab.—Oberon, Rydal, Gynken (Blue Mountains), New South Wales.

The above is the species wrongly labelled *C. brevicollis* Haag-Rut., in the Macleay Museum, noted by me in the revision of the genus (These Proceedings, 1906, p. 238). I have a large number of specimens taken by my son, R. B. Carter at Gynken in January, 1910, of which fifteen are under examination. The colour varies from a bright violet-bronze to dark bronze, and tends to become darker with age. The small, but distinct, hind angles to prothorax, and its bright colour distinguish it from *C. brevicollis* H.-Rut., while it differs from *C. æripennis* Blackb., by colour, and much less pronounced hind angles; from *C. æricollis* Pasc., it differs in its larger size, wider prothorax, anterior angles rounded, more convex elytral intervals, etc.

C. brevicollis Haag-Rut.—Having with some certainty identified *C. curvipes* Bates, as a species taken by me at Dalveen, South Queensland, I feel equally confident that the species referred to, in my revision, as *C. curvipes* (These Proceedings, 1906, p.239), from Jindabyne, is really *C. brevicollis* Haag-Rut. The species also occurs at Nowra (Coll. Taylor).

C. lachlanensis Cart.—I take this opportunity to correct a geographical mistake made in describing this species. Instead of Condobolin, its habitat is Coonabarabran, New South Wales, so that the name *lachlanensis* is unfortunate.

CARDIOTHORAX TIBIALIS, n.sp.

Elongate, subparallel, and somewhat cylindrical, dark bronze, moderately nitid above, darker and very nitid beneath.

♂. *Head* with epistoma produced forward in the middle, and striolate, the usual frontal impression, with scattered foveæ at centre and a line of small foveæ near base of this impression; antennæ stout, with third joint a little longer than fourth, joints 6-10 round, eleventh cupola-shaped. *Prothorax* rather flat, 5 × 6 m.m., length measured in the middle: widest in front of middle, wider at apex than at base, arcuate-emarginate at apex, sinuately emarginate at base; anterior angles rounded, with extreme border acute, sides rounded slightly and narrowing towards base, then abruptly sinuate before the hind angle, this rectangular, contorted downwards and outwards; sides foliaceous and lightly wrinkled, extreme margin raised at sides and base, thickened at the anterior angles, flat and little raised at apex; disc strongly and unevenly canaliculate at centre, a long deep impression on each side of central line, sometimes nearly joined by a transverse impression at their basal end, a round fovea outside each longitudinal impression. *Scutellum* cordate, with a triangular depression behind. *Elytra* 11 × 5·5 mm., subparallel for the greater part of their length; shoulders prominent but rounded, epipleural fold reflexed and emphasised; disc with eight well marked sulci above, a row of large, close punctures on sides, and a further sulcus on extreme outside, intervals strongly convex, the third, fifth, and seventh slightly more raised than the intervening intervals (though this character is variable in my specimens); the eighth (on sides) not extending to base, the fifth and seventh disconnected at apex, and enclosed by connected pairs of intervals; epipleuræ smooth. Under surface smooth, fore tibiæ with inner surface swollen and subnodulose in the middle, curved and carinate on outside edge, tufted and expanded at apex, with one long and one very short spur on inside of apex; intermediate tibiæ with a smaller enlargement near base, posterior tibiæ curved and armed with a row of tubercles on the inside.

♀. Size larger, tibiæ very little curved, and without the tibial swellings or tubercles noted above, posterior tarsi longer. *Dimensions*, ♂ 17 × 6 mm.; ♀ 19 × 6·5 mm.

Hab.—Dalveen, South Queensland.

Thirteen specimens were taken by the author in January, 1911, five males, eight females. The strongly marked sexual characters of the tibiæ in the above species will sufficiently differentiate it. It is otherwise closely allied to *C. opacicollis* Macl., (of which I have cotypes), other differences being that, in *C. opacicollis*, the antennal joints are more elongate, the prothorax is longer than broad, with larger and more acute posterior angles, the elytral intervals are regular and its colour is opaque black.

ADELIUM ARBORICOLA, n.sp.

Rather widely ovate; head, thorax, and legs metallic green; elytra brown, with a greenish tint; abdomen dark metallic chestnut, very nitid; oral organs, antennæ, tarsi, and tibial vestiture light red.

Head coarsely and regularly punctate, labrum prominent, epistoma rounded, not reflexed, limiting suture wide, deep and semicircular; canthus raised, steeply declivous behind; eyes large and wide, forehead depressed, antennæ very long and slender, in ♀ extending beyond base of prothorax; in ♂ still longer; third joint shorter than fourth and fifth combined; joints 4-10 successively larger and wider, obconic, eleventh larger and wider than tenth, ovate. *Prothorax*, of ♂, 3 × 4·5 mm.; of ♀, 4 × 5 mm.; wider at base than apex, widest at middle; apex subtruncate, with rounded obtuse anterior angles slightly advanced, sides widely rounded, slightly sinuate at base, base subtruncate (a little advanced in the middle), posterior angles widely obtuse; margins moderately foliaceous, extreme border very narrowly raised throughout. Disc with a few irregular inequalities of surface, close and finely punctate (punctures finer and less deep than on head), central line in general faintly indicated. *Scutellum* triangular. *Elytra* ovate, convex, nearly thrice the length of prothorax, and much wider than it at base, shoulders rounded, sides not widened behind, tapering, not sinuate, to apex, border very narrow, not evident throughout from above; each elytron with ten rows of very unequal, more or less elongate punctures, the tenth at extreme sides in a deep sulcus, intervals minutely punctate, sometimes joined reticulately crossways and obliquely, becoming convex laterally, and substriate. *Epipleuræ*, underside, and legs minutely punctate, abdomen smooth and (in both sexes) strongly impressed at sides. Intercoxal process widely truncate in front and margined. Fore tibiæ slightly curved, all tibiæ minutely bispinose at apex, with a thin line of pale red hair on the inside edge. *Dimensions* 12-14 × 5-6 mm.

Hab.—Acacia Creek, New South Wales (H. J. Carter); Wilson's Peak, Killarney district, Queensland (R. Illidge).

Eight specimens taken by the author, and one sent by Mr. Illidge, form a curious instance of one species of a genus of ground-beetles taking to arboreal habits. My specimens were beaten from overhanging creepers in dense scrub, and Mr. Illidge had previously informed me of its occurrence only on foliage. It is allied to *A. ruptum* Pasc., from which it differs in its shorter and more convex shape, its brightly varnished surface, bright red antennæ and tarsi, its prothorax much less narrowed at base, and its very unequal elytral punctures. I have a specimen of *A. ruptum* Pasc., which I compared with the type, whose dimensions are 15 × 4·5 mm. *A. arboricola* belongs to my Section ii., Subsection C.

ADELIUM CYANEUM, n.sp.

Subparallel, rather flat, blue varying from violet to peacock blue-green, very nitid and smooth above, underside nitid coppery-bronze; oral organs, antennæ, and tarsi fuscous.

Head strongly punctate, punctures larger on forehead, labrum emarginate; epistoma convex and round in front, limiting suture straight and deeply impressed, continued obliquely backwards to eyes, front slightly depressed; antennæ short, not reaching base of prothorax, third joint little longer than fourth, 4-8 successively wider, obconic, 9-10 subtriangular, eleventh largest, ovate. *Prothorax*, 2·5 × 4 mm. in ♀; 2 × 3·5 mm. in ♂; almost semicircular at apex, truncate at base, widest at middle, equally wide at base and apex, all angles obtuse, sides widely rounded, sinuate near base, with a thin raised border throughout, margins slightly explanate but not differentiated in sculpture from disc, the latter uniformly closely and finely punctate, a slight foveate depression on each side at base, and elongate lateral foveæ, the male specimen with a very faint indication of a central line. *Scutellum* rather widely triangular. *Elytra* truncate ovate, slightly convex, wider than prothorax at base, and rather more than twice as long, shoulders nearly square, not widened behind, punctate-striate, each elytron with ten well marked striæ, intervals flat near suture, becoming strongly convex at sides, punctures in striæ small, close, and almost concealed, but forming little notches on sides of intervals, these also minutely punctate. *Epipleuræ* coarsely, prosternum and parapleuræ sparingly and more finely, abdomen and legs minutely punctate; intercoxal process with margin rounded. Legs slender, fore tibiæ slightly curved. *Dimensions*, 7-9 mm. × 3-4 mm.

Hab. - Cairns, North Queensland.

Two specimens, given to me some time ago by Mr. Hacker, are evidently conspecific; the smaller, evidently male, has the elytra of a brilliant purple colour, with the pronotum blue; the larger specimen, probably female, is of a peacock-blue colour. It is a member of my Section ii., Subsection D; but, like *A. Fergusoni* Cart., it has the elytral striæ convex at the sides, but is distinguished from that species by its brilliant colour, and widely obtuse hind angles to prothorax; and from all other species by its colour alone, except *A. cæruleum* Cart., from which it widely differs in other respects.

EXPLANATION OF PLATE VIII.

Platycilibe brevis, n.sp.

Fig. 1—Oral organs.
Fig. 2—Antenna.
Fig. 3—Anterior leg.
Fig. 4—Intermediate leg.
Fig. 5—Posterior leg.

REVISION OF AUSTRALIAN TORTRICINA.

By E. Meyrick, B.A., F.R.S., Corresponding Member.

(*Continued from Vol. xxxv., pp.* 139-294).

4. EUCOSMIDÆ.

Ocelli present. Forewings with 2 from before ¾ of cell. Hindwings with basal pecten on lower margin of cell.

This family is very largely developed throughout the whole northern hemisphere, but is less conspicuous in Africa and South America, whilst in Australia and New Zealand it is much inferior in numbers to the *Tortricidæ*. The real extent of its inferiority in Australia, however, is partially disguised by the number of species of Indo-Malayan type (especially in the genus *Argyroploce*), which have penetrated into Queensland. It forms roughly four natural groups, viz., (*a*) the primitive *Laspeyresia*-group, with 5 of hindwings parallel to 4 (genera 66-7); (*b*) the *Argyroploce*-group, with crested thorax, to which *Bactra* truly belongs, though it has lost the crest (genera 57-65); (*c*) the typical *Eucosma*-group (genera 52-56); and (*d*) the *Spilonota*-group, with notch in stalk of antennæ in ♂ (genera 49-51).

1. Hindwings with 5 approximated to 4 at base or absent	**2.**
Hindwings with 5 nearly parallel to 4	**18.**
2. Thorax smooth	**3.**
Thorax with posterior crest	**11.**
3. Antennæ in ♂ with notch on stalk	**4.**
Antennæ in ♂ without notch on stalk	**6.**
4. Forewings with 7 and 8 stalked	**49. HERMENIAS.**
Forewings with 7 and 8 separate	**5.**
5. Hindwings with 6 and 7 stalked	**50. BATHROTOMA.**
Hindwings with 6 and 7 approximated	**51. SPILONOTA.**
6. Forewings with 7 and 8 stalked	**52. ACROCLITA.**
Forewings with 7 and 8 separate	**7.**

7.	Apex of forewings falcate	53. ANCYLIS.
	Apex of forewings not falcate	8.
8.	Hindwings with 3 and 4 separate	9.
	Hindwings with 3 and 4 connate or stalked	10.
9.	Hindwings with 6 and 7 approximated	54. HERPYSTIS.
	Hindwings with 6 and 7 stalked	57. BACTRA.
10.	Forewings with 7 to termen	55. EUCOSMA.
	Forewings with 7 to costa	56. PROCORONIS.
11.	Hindwings with 5 absent	60. STERIPHOTIS.
	Hindwings with 5 present	12.
12.	Hindwings with 3 and 4 approximated	13.
	Hindwings with 3 and 4 connate or stalked	16.
13.	Forewings with 7 and 8 stalked	62. ANATHAMNA.
	Forewings with 7 and 8 separate	14.
14.	Hindwings with 6 and 7 stalked	58. POLYCHROSIS.
	Hindwings with 6 and 7 approximated	15.
15.	Forewings with 8 and 9 approximated, 10 and 11 approximated	59. LOBESIA.
	Forewings with 8-11 normal	61. PROSCHISTIS.
16.	Forewings with 7 to costa	63. HELICTOPHANES.
	Forewings with 7 to termen	17.
17.	Forewings with 8 and 9 separate	64. ARGYROPLOCE.
	Forewings with 8 and 9 stalked or appressed towards base	65. ARTICOLLA.
18.	Forewings with median dorsal scaletooth	66. PTERNIDORA.
	Forewings without median dorsal scaletooth	67. LASPEYRESIA.

49. HERMENIAS, n.g.

Antennæ in ♂ ciliated, with an excavated notch in stalk near base. Palpi moderate, porrected, second joint with dense rough projecting scales above and beneath, terminal joint moderate. Thorax without crest. Forewings with 7 and 8 stalked, 7 to apex or termen. Hindwings with 3 and 4 stalked or coincident, 5 closely approximated, 6 and 7 closely approximated towards base.

Type *H. epidola* Meyr. Besides the following two species, I have three from Ceylon. The genus is a development of *Spilonota*.

291. *H. epidola*, n.sp.

♂♀ 17-18 mm. Head, palpi, and thorax fuscous sprinkled with white. Antennal notch in ♂ close above base. Forewings elongate, narrow, somewhat contracted posteriorly, costa gently arched, in ♂ with broad fold reaching from base nearly to ¾, apex obtuse, termen slightly rounded, oblique; 7 to apex; fuscous, suffusedly irrorated with white, with irregular oblique dark streaks and strigulæ from costa; a more or less indicated median longitudinal streak of dark suffusion from base to apex, marked with several variable irregular longitudinal dark fuscous marks, lower edge with more or less marked triangular prominences before and beyond middle: cilia fuscous suffusedly irrorated with white, at apex with a dark fuscous bar, base on termen spotted with dark fuscous. Hindwings with 3 and 4 stalked; in ♂ pale whitish-grey, on dorsum with long whitish hairs, cilia whitish; in ♀ pale grey, cilia grey-whitish.

VICTORIA: Gisborne, Macedon (Lyell)—TASMANIA: Deloraine; from August to November, and in May; three specimens.

292. *H. imbrifera*, n.sp

♂♀. 11-14 mm. Head, palpi, and thorax grey, more or less mixed with white. Antennal notch in ♂ at ¼. Forewings elongate, narrow, in ♀ slightly dilated posteriorly, costa hardly arched, in ♂ with moderate fold reaching from base to ⅔, apex obtuse, termen slightly sinuate, rather oblique; 7 to apex; dark fuscous; costal area marked throughout with oblique white streaks, reaching ⅓ across wing; two indistinct streaks of whitish irroration from dorsum before middle, broader in ♀; a rather broad oblique whitish patch from dorsum beyond middle, reaching half across wing; tornal area irrorated with whitish, with four leaden-metallic spots indicating margins of ocellus: cilia dark fuscous irrorated with white. Hindwings with 3 and 4 stalked; fuscous, in ♂ thinly scaled and semihyaline in disc and towards base, less so in ♀, darker fuscous towards apex; cilia pale fuscous, in ♀ with darker subbasal line.

VICTORIA: Gisborne (Lyell); from October to January, and in May, three specimens. Type in Coll. Lyell.

50. BATHROTOMA Meyr.

Bathrotoma Meyr., Proc. Linn. Soc. N S.Wales, 1881, 675... ... type *constrictana*.

Antennæ in ♂ ciliated, with an excavated notch just above basal joint. Palpi moderate, porrected, second joint with rough projecting hairs above and beneath, terminal joint moderate. Thorax without crest. Forewings with 7 separate, to termen. Hindwings with 4 absent, 5 approximated to 3 at base, 6 and 7 stalked.

Contains only the two following species.

293. *B. constrictana* Meyr.

(*Bathrotoma constrictana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 675).

New South Wales: Sydney - South Australia: Port Lincoln; from September to November, in January, and March. The single example from Port Lincoln has the head mostly suffused with whitish, the characteristic brown colour of face and palpi being almost obsolete, but otherwise agrees fully with Sydney examples, and cannot be specifically separated.

294. *B. ruficomana* Meyr.

(*Bathrotoma ruficomana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 676).

New South Wales: Sydney; in September, December, and January.

51. Spilonota Steph.

Spilonota Steph., Cat. Brit. Ins. 173(1829) ...	type *ocellana*.
Tmetocera Led., Wien. Ent. Mon. iii., 367(1859)	type *ocellana*.
Monilia Walk., Cat. xxxv., 1741(1866) ..	type *semicanella*.
Strepsiceros Meyr., Proc. Linn. Soc. N.S.Wales, 1881, 678(praeocc.)	type *ejectana*.
Strepsicrates Meyr., Trans. N.Z. Inst., 1887, 73	type *ejectana*.

Antennæ in ♂ ciliated, with an excavated notch in stalk towards base. Palpi moderate or rather long, porrected, second joint with dense projecting scales above and beneath, sometimes tufted beneath, terminal joint short or moderate. Thorax without crest. Forewings with 7 separate, to termen. Hindwings with 3 and 4 stalked or coincident, 5 nearly approximated, 6 and 7 closely approximated towards base.

The definition of this genus being now widened to include forms without a costal fold, it is represented in all the principal regions, but apparently very scantily everywhere except in Australia and New Zealand; as, however, the species are often very obscure and inconspicuous, they are easily overlooked.

295. *S. infensa*, n.sp.

♂ 17-18 mm. Head, palpi, and thorax dark fuscous, somewhat pale-sprinkled, palpi rather long. Antennal notch very near base. Forewings elongate, narrow, slightly dilated posteriorly, costa slightly arched, with broad fold reaching from base to $\frac{3}{5}$, apex obtuse, termen straight, somewhat oblique; blackish-fuscous; costa with faint whitish strigulæ posteriorly; a broad brownish-ochreous band suffusedly irrorated with whitish extending along dorsum throughout, occupying nearly half of wing, upper edge indented by an inwardly oblique brown mark at $\frac{2}{3}$; ocellus limited by two leaden-metallic transverse streaks, very obscure on upper part of wing, included area on dorsal band brownish with black dashes on veins, and also margined anteriorly on this band by a brown spot streaked with black on veins: cilia fuscous mixed with dark fuscous and irrorated with white, on tornal area sometimes mixed with ferruginous-brown. Hindwings with 3 and 4 stalked; fuscous, veins darker; cilia light fuscous, with darker subbasal line, tips whitish.

QUEENSLAND: Brisbane (Turner); in November, two specimens.

296. *S. macropetana* Meyr.

(*Strepsiceros macropetana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 683).

QUEENSLAND: Duaringa (Barnard), Brisbane—NEW SOUTH WALES: Broken Hill (Lower), Glen Innes (4,500 feet), Newcastle, Sydney, Bulli, Blackheath (3,500), Bathurst, Cooma—VICTORIA: Gisborne, Dimboola (Lyell), Melbourne, Healesville, Casterton—SOUTH AUSTRALIA: Mount Gambier, Mount Lofty, Wirrabara, Port Lincoln—WEST AUSTRALIA : Perth; throughout the year. Larva between joined leaves of *Eucalyptus.*

297. *S. semicanella* Walk.

(*Monilia semicanella* Walk., Cat. xxxv., 1741; *Strepsiceros lasiophora* Low., Trans. Roy. Soc. S. Austr. xxxii.(1908), 323).

NEW GUINEA: Sudest Island (Meek)—QUEENSLAND: Townsville (Dodd), Duaringa (Barnard), Brisbane (Turner) - NEW SOUTH WALES : Sydney; in September, and from March to June.

298. *S. limnephilana* Meyr.

(*Strepsiceros limnephilana* Meyr., Proc. Linn. Soc. N S. Wales, 1881, 680).

NEW SOUTH WALES : Newcastle; in January. I have seen no further examples.

299. *S. ejectana* Walk.

(*Sciaphila ejectana* Walk., Cat. xxviii., 350; *S. servilisana* ib. 356; *S. saxana* ib. 357; *Conchylis ligniferana* ib. 363; *Strepsiceros ejectana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 681).

Q.: Brisbane (Lyell)—N.S.W.: Sydney, Mittagong, Cooma (3,000 feet)—VIC : Gisborne (Lyell), Melbourne - TASM.: George's Bay—S. AUST.: Mount Gambier (Guest), Mount Lofty, Port Lincoln—W. AUST.: Albany, Fremantle: from July to March. Common also throughout New Zealand. Larva amongst spun shoots of *Kunzea, Darwinia, Leptospermum,* and perhaps other Myrtaceæ.

300. *S. sicariana* Meyr.

(*Strepsiceros sicariana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 691).

N.S.W.: Sydney; in February. The type is still unique.

301. *S. obeliscana* Meyr.

Strepsiceros obeliscana Meyr., Proc. Linn. Soc. N.S.Wales, 1881, 690).

Q.: Stanthorpe (Turner)—N.S.W.: Sydney, Bathurst—S. Aust.: Mount Lofty—W. Aust.: Perth, Albany; from June to December, amongst *Leptospermum*.

302. *S. plinthinana* Meyr.

(*Strepsiceros plinthinana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 689).

N.S.W.: Parramatta; in November. Still unique.

303. *S. vitiosa*, n.sp.

♂. 12 mm. Head and palpi white. Antennæ with notch at ⅓. Thorax grey anteriorly suffused with white. Forewings elongate, posteriorly slightly dilated, costa gently arched, with rather narrow fold reaching from base to ⅓, apex obtuse, termen somewhat sinuate, rather oblique; dark fuscous, irrorated with white points; costa obliquely strigulated with white; several blackish strigulæ on dorsum; a broad white streak extending beneath costa from base to ⅔, margined beneath posteriorly by an elongate black mark; an elongate-oval white spot extending beneath costa from above apex of this to ¾, edged beneath with blackish, and connected with costa by three white strigulæ; beyond this an acute white mark formed of two converging costal strigulæ, edged beneath by a black dash; ocellus margined by two transverse leaden-metallic streaks, anterior preceded on its lower portion by a small blackish spot, posterior preceded in disc by two black dots, and extended to join a small white spot on costa before apex : cilia dark fuscous irrorated with white points, with a white patch occupying most of termen towards base, and a white spot on costal anteapical spot. Hindwings with 3 absent; fuscous; cilia fuscous-whitish.

S. Aust.: Mount Lofty (Lower); one specimen.

304. *S. zopherana* Meyr.

(*Strepsiceros zopherana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 688).

N.S.W. : Sydney—Vic. : Beaconsfield (Lyell)—W. Aust. : Albany; from August to March. Also common in New Zealand.

305. *S. sollicitana* Meyr.

(*Strepsiceros sollicitana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 687).

Q.: Brisbane; N.S.W.: Sydney; from October to January.

306. *S. chalcitis*, n.sp.

♂. 17 mm. Head, palpi, and thorax dark fuscous, palpi rather long, terminal joint with some white scales at base and apex. Antennæ with *notch* at ¼. Forewings elongate, rather narrow, costa gently arched, with broad fold reaching from base to near middle, apex obtuse, termen slightly rounded, oblique; dark bronzy-fuscous; an oblique rhomboidal patch of whitish suffusion from dorsum beyond middle, reaching nearly half across wing; anterior edge of ocellus indicated by a very obscure rather oblique transverse greyish mark: cilia bronzy-fuscous sprinkled with whitish, extreme base spotted with white and dark fuscous. Hindwings with 3 and 4 stalked; rather dark fuscous; cilia whitish-fuscous, with fuscous subbasal line.

TASM.: Blue Tier (Simson); one specimen.

307. *S. tarachodes*, n.sp

♂♀. 10-12 mm. Head, palpi, and thorax fuscous, slightly sprinkled with whitish, in one specimen head suffused with whitish Antennæ in ♂ with notch at ⅙. Forewings elongate, costa gently arched, in ♂ with moderate fold reaching from base to beyond ⅖, apex obtuse, termen nearly straight, oblique; bronzy-fuscous, sprinkled with dark fuscous; two parallel, approximated, oblique white streaks from dorsum about ⅔, reaching half across wing; a white streak from ¾ of costa to near tornus; costa posteriorly obscurely strigulated with white: cilia fuscous, somewhat mixed with dark fuscous and whitish, with white basal patches at apex and tornus. Hindwings with 3 and 4 stalked; grey; cilia whitish, with grey subbasal line.

TASM.: Mount Wellington, 3,600 feet; in December, three specimens. These are not in good condition, and the description may, therefore, need improvement, but the species is distinct.

308. *S. spanistis*, n.sp.

♂ 13 mm. Head, palpi, and thorax rather dark grey, sprinkled with white. Antennæ with notch at ⅙. Forewings elongate, costa gently arched, fold short and very slight, almost obsolete, apex round-pointed, termen slightly sinuate, somewhat oblique; dark fuscous, bases of scales whitish; costa strigulated throughout with white; submedian fold from base to middle white and transversely strigulated with white; two approximated nearly direct white streaks from dorsum beyond middle, reaching half across wing; a white streak from ⅔ of costa to tornus: cilia fuscous mixed with dark fuscous, with white basal patches on tornus and beneath apex. Hindwings with 3 and 4 stalked; rather dark fuscous; cilia pale fuscous, with darker subbasal shade.

N.S.W.: Mount Kosciusko, 5,000 feet; in January, one specimen. Allied to the preceding, but distinguished from it and all other Australian species by the costal fold being almost obsolete.

309. *S. morosa*, n.sp.

♂♀. 10-12 mm. Head, palpi, and thorax light fuscous, sometimes sprinkled with white. Antennæ in ♂ with notch at ⅙. Forewings elongate, rather dilated posteriorly, costa gently arched, in ♂ with moderate fold reaching from base to ⅖, apex obtuse, termen somewhat sinuate, rather oblique; fuscous, more or less suffused with ochreous on posterior third, slightly sprinkled with whitish; costa strigulated with white on posterior ⅗, in ♀ anteriorly also; usually a more or less marked streak of white suffusion and strigulation along submedian fold from base to middle; a transverse patch of white suffusion or strigulation from dorsum beyond middle, reaching more than half across wing, often indistinctly defined; ocellus enclosed by two leaden-metallic transverse striæ, and marked with three or four black dashes on lower half of wing: cilia fuscous, on termen white towards base. Hindwings with 3 and 4 stalked; dark fuscous; cilia grey, with dark fuscous subbasal shade.

N.S.W.: Bathurst—TASM.: Deloraine; in November and December, twelve specimens.

310. *S. fluidana* Meyr.

(*Strepsiceros fluidana* Meyr., Proc. Linn. Soc. N.S.Wales, 1881, 686)

N.S.W.: Sydney, Bulli, Blackheath (3,500 feet), and Bathurst; from July to March. Larva in spun shoots of *Leptospermum lanigerum*.

311. *S. tranquilla*, n sp.

♂♀. 12-15 mm. Head, palpi, and thorax grey sprinkled or suffused with white. Antennæ in ♂ with notch at $\frac{1}{5}$. Forewings elongate, posteriorly slightly dilated, costa gently arched, in ♂ with moderate fold extending from base to near middle, apex obtuse, termen hardly sinuate, rather oblique; rather dark grey or brownish-ochreous, irrorated with white, in ♀ sometimes largely suffused with white towards costa; costa sometimes strigulated with white posteriorly; in ♀ sometimes a transverse whitish patch from dorsum beyond middle, anterior edge straight and somewhat edged with blackish scales, posterior edge suffused; ocellus margined laterally by two leaden-metallic transverse streaks, sometimes enclosing about three black linear dots, more usually unmarked: cilia grey irrorated with white. Hindwings with 3 and 4 stalked; grey, darker posteriorly; cilia whitish-grey, with darker subbasal shade.

TASM.: Deloraine; in November, eight specimens. Nearest *S. fluidana*, but larger and greyer, termen of forewings much less sinuate, hindwings of ♂ darker in disc.

312. *S. honesta*, n.sp.

♂♀. 14-16 mm. Head and palpi in ♂ grey sprinkled with whitish, in ♀ ochreous-whitish. Antennæ in ♂ with notch at $\frac{1}{4}$. Thorax light ochreous sprinkled or suffused with whitish. Forewings elongate, posteriorly slightly dilated, costa gently arched, in ♂ with moderate fold reaching from base to middle, apex obtuse, termen in ♂ hardly, in ♀ distinctly sinuate, rather oblique; ochreous, somewhat mixed with grey, and partially sprinkled with white; in ♀ a patch of white suffusion along anterior half of costa, and dorsum suffused with whitish anteriorly; a somewhat curved oblique white streak from middle of dorsum, reaching half across wing, well-defined anteriorly, suffused posteriorly, in ♀ much broader and extended above middle to ⅘ of disc, the extension represented in ♂ only by a cloudy white spot in disc at ¾; posterior half of costa strigulated with white, more distinctly in ♀; ocellus enclosed by two leaden-metallic transverse striæ, enclosing three ill-defined short fine black dashes in middle portion of wing, anterior stria preceded by a black dash above fold: cilia leaden-grey irrorated with white. Hindwings with 3 and 4 stalked; grey, darker posteriorly; cilia grey-whitish, with grey subbasal shade.

Vic.: Geelong (Trebilcock), Macedon, Melbourne—Tasm.: Deloraine; in November and December, five specimens

313. *S. seditiosana* Meyr.

(*Strepsiceros seditiosana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 684).

N.S W.: Sydney, Bulli; from August to October.

314. *S. pericyphana* Meyr.

(*Strepsiceros pericyphana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 685).

N.S.W.: Sydney; in October.

52. ACROCLITA Led.

Acroclita Led., Wien. Ent. Mon. iii., 329(1859)	type *consequana*.
Rhopobota Led., Wien. Ent. Mon. iii., 366 (1859)	type *nævana*.
Palæobia Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 660	type *hibbertiana*.
Holocola Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 669	type *thalassinana*.

Antennæ in ♂ simple or shortly ciliated. Palpi moderate, porrected or seldom ascending, second joint with projecting scales or long rough hairs above and beneath, terminal joint short or moderate. Thorax without crest. Forewings with 7 and 8 stalked, 7 to termen. Hindwings with 3 and 4 stalked or coincident, 5 approximated, 6 and 7 closely approximated towards base.

This genus also is now widened to include forms with and without the costal fold; it is principally characteristic of the Indo-Malayan and Australian regions, being represented elsewhere only by a few stragglers.

315. *A. longestriata* Durr.

(*Palæobia longestriata* Durr., Proc. Linn. Soc. N. S. Wales, 1891, 17).

♂♀. 15-17 mm. Head and thorax ochreous. Forewings whitish-ochreous, veins lined with ferruginous-ochreous; some ferruginous-ochreous suffusion towards dorsum; a rather broad deep ferruginous streak beneath middle from near base to ¾, obliquely interrupted before middle of wing. Hindwings dark grey.

N.S.W.: Tumut (Peel), Mount Kosciusko, 6000 feet (Helms)—Tasm.: Deloraine; in December and March. This species, except for the more ferruginous colouring, has much the superficial appearance of a *Bactra*.

316. *A. hibbertiana* Meyr.

(*Palæobia hibbertiana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 665).

N.S.W.: Sydney, Bulli; from September to December, and in March. Larva mining in leaves of *Hibbertia volubilis*.

317. *A. himerodana* Meyr.

(*Palæobia himerodana* Meyr., Proc. Linn. Soc. N S. Wales, 1881, 666)

N.S.W.: Murrurundi; in November.

318. *A. mesoscia*, n.sp.

♂. 16 mm. Head and thorax whitish-fuscous. Palpi fuscous-whitish, second joint with long rough hairs. Forewings elongate, costa moderately arched, without fold, apex obtuse, termen sinuate, somewhat oblique; pale greyish-ochreous, with a few scattered dark fuscous scales; costa obliquely strigulated with brown and dark fuscous; a roundish patch of dark fuscous suffusion towards dorsum at $\frac{1}{3}$; a broad brown streak, including several longitudinal black marks, extending from middle of disc to apex, dilated anteriorly; a black line along median portion of termen: cilia pale brownish with rows of whitish points, at apex with a dark brown bar. Hindwings with 3 and 4 stalked; grey, veins dark fuscous; cilia grey-whitish, with two grey shades.

VIC.: Mount Macedon (Lyell); one specimen. Type in Coll. Lyell. Allied to *A. volutana*, but apparently distinct.

319. *A. volutana* Meyr.

(*Palæobia volutana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 663).

VIC.: Beaconsfield (Drake), Lorne (Lyell), Warragul; in December and March. Not a common species, but I have now seen four specimens.

320. *A. anguillana* Meyr.

(*Palæobia anguillana* Meyr., Proc. Linn. Soc. N.S.Wales, 1881, 662).

N.S.W.: Sydney—VIC.: Beaconsfield, Lorne (Lyell)—S AUST.: Port Lincoln; from August to November, and in March. Larva in spun shoots of *Correa speciosa*.

321. *A. erythrana* Meyr.

(*Palæobia erythrana* Meyr., Proc Linn. Soc. N. S. Wales, 1881, 664).

N.S.W.: Sydney; in October. I subsequently took a second specimen.

322. *A. infectana* Meyr.

(*Palæobia infectana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 663).

N.S.W.: Sydney, Mittagong (2,000 feet); in August, March, and April

323. *A. artifica*, n.sp.

♂. 13 mm. Head whitish, sides spotted with dark fuscous, crown suffused with pale brownish. Palpi whitish, second joint with long rough spreading hairs, with a small dark fuscous median spot, tuft tinged with grey. Thorax light brownish-grey, shoulders suffused with white, with a small dark fuscous spot. Forewings elongate, costa gently arched, without fold, apex obtuse, termen sinuate, somewhat oblique; ferruginous-brown; a broad white streak occupying costal half of wing from base to $\frac{2}{5}$, thence bent downwards and narrowed to tornus, where it joins ocellus, strigulated with dark fuscous on costa and including some small dots or strigulæ of ground-colour; dorsal area within this streak suffused with grey and strigulated with dark fuscous; ocellus represented by a rounded white patch somewhat sprinkled with pale grey, and including two or three hardly defined darker marks on veins, with one or two black scales; posterior half of costa very obliquely strigulated with white, one from beyond middle extended as a white line nearly to termen beneath apex; one or two undefined blackish streaks on veins in posterior part of disc passing above ocellus; apex dark fuscous: cilia whitish, at apex with a dark fuscous bar. Hindwings with 3 and 4 stalked; fulvous-fuscous, darker posteriorly; cilia fuscous-whitish, with fuscous subbasal shade.

Q.: Brisbane (Turner); two specimens.

324. *A. coronopa*, n.sp.

♂♀. 16-17 mm. Head, palpi, and thorax ochreous-grey-whitish, palpi with slender more or less marked brownish median bar, thorax partially tinged with brownish. Forewings elongate, posteriorly slightly dilated, costa gently arched, without fold, apex round-pointed, prominent, termen concave, rather oblique; light greyish-ochreous, much mixed and suffused irregularly with whitish; costa strigulated with whitish, interspaces mixed with blackish except posteriorly; a triangular patch of irregular grey suffusion and blackish strigulation extending along dorsum from near base to $\frac{3}{4}$ and reaching half across wing, in ♂ little marked towards dorsum posteriorly; a moderate darker greyish-ochreous streak, longitudinally streaked with black, running from middle of costa obliquely outwards to disc and thence to apex; a black line on termen: cilia whitish-ochreous mixed with white, basal third somewhat marked with blackish, with an apical bar of blackish suffusion. Hindwings light grey, apex somewhat suffused with whitish, apical margin with some blackish dots; cilia whitish, with two pale ochreous or greyish-ochreous shades.

Vic.: Beaconsfield (Drake); in March, two specimens. Types in Coll. Drake.

325. *A. colonota*, n.sp.

♂♀. 11-13 mm. Head and thorax pale reddish-ochreous. Palpi whitish-ochreous, second joint with long rough spreading hairs, with an apical spot of dark fuscous suffusion. Forewings elongate, posteriorly slightly dilated, costa gently arched, in ♂ without fold, apex obtuse, termen sinuate-concave, rather oblique; ochreous; costa with short scattered dark fuscous strigulæ; basal ⅔ of wing usually strewn with dark fuscous strigulæ; a rounded-triangular dark fuscous blotch in disc beyond middle, undefined beneath, margined anteriorly by a patch of white suffusion often produced as a streak towards base, and posteriorly by a suffused white streak connected with a pair of white strigulæ on middle of costa; three pairs of white costal strigulæ between this and apex; ocellus more or less completely edged with leaden-metallic, anteriorly adjoining the white streak; a blackish terminal line: cilia light grey more or less mixed with light reddish-ochreous. Hindwings with 3 and 4 stalked; grey; cilia grey-whitish, with grey subbasal shade.

W. Aust.: Perth, Albany; from October to December, eight specimens.

326. *A. synomotis*, n.sp.

♂♀. 13-15 mm. Head and thorax pale ochreous, forehead between antennæ suffused with dark fuscous. Palpi ochreous-whitish, second joint with long rough projecting scales, with a small dark fuscous median spot, and apical patch of dark fuscous suffusion. Forewings elongate, posteriorly slightly dilated, costa gently arched, in ♂ without fold, apex round-pointed, termen concave, rather oblique; brownish-ochreous, suffused with grey towards dorsum anteriorly, and with brown towards termen and posterior half of costa and dorsum; basal third of wing with some scattered black dots; costa strigulated with black; dorsum with some suffused blackish strigulæ; a leaden-grey line from middle of costa to termen beneath apex, costa beyond this with several whitish strigulæ; ocellus rather large, closely irrorated with white, partially edged laterally with leaden-metallic and margined anteriorly and above by some dark fuscous suffusion; a small blackish apical spot; a fine blackish terminal line: cilia grey, round apex mixed with blackish, on median area of termen with a whitish patch. Hindwings with 3 absent; fulvous-ochreous, posteriorly suffused with fuscous, darkest at apex; cilia light ochreous-grey.

N.S.W: Sydney; in November and April, two specimens.

327. *A. fidana* Meyr.

(*Palæobia fidana* Meyr, Proc. Linn. Soc. N.S. Wales, 1881, 667).

N.S.W.: Sydney—Tasm.: George's Bay; from September to March.

328. *A. segetana* Meyr.

(*Palæobia segetana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 669).

Vic.: Beaconsfield (Lyell), Warragul (Raynor), Healesville; in November and December.

329. *A. psæustis*, n.sp.

♂♀. 9-10 mm. Head and thorax pale greyish-ochreous, face more whitish. Palpi ochreous-whitish, second joint with long rough projecting hairs, with two small dark fuscous spots and an apical patch of dark fuscous suffusion. Forewings elongate, slightly dilated posteriorly, costa moderately arched, in ♂ without fold, apex round-pointed, termen concave, oblique; whitish-ochreous irrorated with light grey, with scattered dark fuscous strigulæ, costa and dorsum strongly strigulated with dark fuscous, on posterior half of costa with alternate white strigulæ; ocellus moderate, round, suffused with silvery-whitish: a blackish terminal line: cilia light grey, round apex with two dark grey lines, on median area of termen with a whitish patch. Hindwings with 3 absent; grey; cilia grey-whitish.

S. AUST.: Adelaide—W. AUST.: Perth, Geraldton; in October, fourteen specimens

330. *A. biscissana* Meyr.

(*Holocola biscissana* Meyr., Proc Linn. Soc. N. S. Wales, 1881, 674).

N.S.W.: Sydney, Bulli—TASM: George's Bay—S. AUST.: Wirrabara, Port Lincoln; from October to January.

331. *A. quietana* Meyr.

(*Holocola quietana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 673).

Q.: Brisbane; in September.

332. *A. ischalea*, n.sp.

♂♀. 10-11 mm. Head and thorax pale ochreous-grey, in ♀ whitish-mixed. Palpi pale greyish, more or less whitish-suffused, second joint rough-haired, with two dark fuscous spots. Forewings elongate, rather narrow, costa slightly arched, in ♂ with moderately broad fold reaching from base to $\frac{2}{5}$, apex round-pointed, termen somewhat sinuate, rather oblique; grey, slightly whitish-sprinkled, in ♀ much suffused with whitish, with irregular oblique transverse dark fuscous marks and strigulæ, costal half in ♂ sometimes mostly suffused with rather dark fuscous; a small undefined whitish spot below middle at $\frac{2}{3}$; ocellus margined laterally by two leaden-metallic streaks: cilia white, suffusedly barred with grey. Hindings with 3 and 4 stalked; grey, veins darker; cilia grey-whitish, with grey subbasal shade.

N.S.W.: Newcastle, Sydney; in September and January, four specimens.

333. *A. perspectana* Walk.

(*Grapholita perspectana* Walk., Cat. xxviii., 393; *Holocola perspectana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 671).

Q: Brisbane—N.S.W.: Glen Innes (3,500), Sydney, Wollongong—Vic.: Gisborne (Lyell), Melbourne—Tasm.: Zeehan (Findlay), Hobart—S. Aust.: Mount Lofty, Kangaroo Island, Quorn, Port Lincoln—W. Aust.: Waroona (Berthoud), Albany, Geraldton; from July to May.

334. *A. thalassinana* Meyr.

(*Holocola thalassinana* Meyr., Proc. Linn. Soc. N.S.Wales, 1881, 672).

N.S.W.: Newcastle, Sydney; in September, and from December to February. Larva in spun shoots of *Leptospermum lævigatum.*

335. *A. capyra*, n.sp.

♂. 14 mm. Head brown. Palpi brown, second joint rough-scaled, terminal joint whitish. Thorax brown, suffused with blackish anteriorly. Forewings elongate, costa gently arched, without fold, apex obtuse, termen sinuate, rather oblique; ferruginous-ochreous, mixed with fuscous and some whitish scales; basal patch occupying $\frac{2}{5}$ of wing, suffused with blackish except towards dorsum posteriorly, where it includes a whitish spot, posterior edge with an irregular median prominence followed by two small raised white spots, upper posterior; central fascia formed by a patch of black irroration on middle of costa, a transverse patch on dorsum before tornus, and an irregular black mark in disc between these; three small blackish-marked spots on costa posteriorly; a longitudinal black mark towards termen above middle; a thick submarginal streak of leaden-grey suffusion along termen: cilia blackish-grey. Hindwings with 3 absent; a subcostal hairpencil from base lying beneath forewings; dark grey, rather thinly scaled; cilia grey, with darker subbasal shade.

N.S.W.: Sydney; in August, one specimen taken on a fence during a high wind. A quite peculiar species.

336. *A. hortaria*, n.sp.

♀. 18 mm. Head and thorax pale whitish-ochreous tinged with green, patagia light brownish. Palpi fuscous, second joint shortly rough-scaled, terminal joint whitish. Forewings elongate, moderate, costa moderately arched, apex round-pointed, prominent, termen sinuate-indented beneath apex, somewhat oblique; pale greyish-ochreous suffused with dull greenish; costal edge dark fuscous, with short paired ochreous-whitish strigulæ; a triangular fuscous patch occupying basal third of costa, its apex broadly connected below middle with a rather broad irregularly sinuate fuscous streak mixed with dark fuscous running from a dark fuscous spot on middle of dorsum to apex; ocellus tinged with silvery-whitish : cilia pale ochreous, on upper part of termen tinged with greenish, at apex with a dark fuscous bar. Hindwings with 3 and 4 stalked; dark grey, veins dark fuscous; cilia pale fuscous, with darker subbasal shade.

Vic : Locality not recorded; one specimen.

337. *A. bryopa*, n.sp.

♂♀. 14 mm. Head ochreous-whitish. Palpi ochreous-whitish, with a few blackish scales, and a blackish median spot on second joint. Thorax whitish-ochreous, shoulders with two or three dark fuscous strigulæ Forewings elongate, moderate, costa moderately arched, in ♂ without fold, apex round-pointed, termen sinuate, rather oblique; greenish-ochreous, suffusedly striated with iridescent-whitish; markings very undefined, indicated by irregular black irroration and strigulation on groundcolour; basal patch indicated by some basal striation, a rounded patch on costa about ¼, and a larger subtriangular dorsal patch before middle; central fascia indicated by a small spot on middle of costa, an irregular patch in disc, and an acute-triangular patch before tornus, sometimes extended ¾ across wing; three small spots on posterior part of costa, and a small black spot at apex; some irregular blackish striation on veins towards termen, between two iridescent grey-whitish streaks limiting ocellus : cilia light greyish-ochreous mixed with whitish and sprinkled with dark fuscous Hindwings with 3 and 4 stalked; rather dark fuscous, rather thinly scaled; cilia fuscous, with darker subbasal shade.

Q.: Mount Tambourine (Turner); in November, two specimens.

338. *A. peltosema* Low.

(*Palæobia peltosema* Low., Trans. Roy. Soc. S. Aust., 1908, 323).

♀. 13 mm. Head and thorax whitish-grey. Forewings elongate, costa slightly arched, apex round-pointed, termen concave, somewhat oblique; light grey, partially tinged with brownish, strigulated with whitish irroration on a broad undefined streak from base of costa to tornus; costa strigulated with black and whitish, with several small wedgeshaped black marks; an undefined triangular darker grey and fuscous patch irregularly marked with black extending over costa from before middle to apex and reaching ⅔ across wing: cilia light grey irrorated with white, with a blackish bar above apex. Hindwings with 3 and 4 stalked; grey, veins dark fuscous

Q.: Mackay. Redescribed from the type in Coll. Lower.

339. *A. tolhastis*, n.sp.

♂. 9 mm Head, palpi, and thorax grey, palpi ascending. Forewings elongate, rather narrow, costa gently arched, without fold, apex obtuse, termen slightly sinuate, rather oblique; grey, suffusedly irrorated with white; costa blackish strigulated with white; outer edge of basal patch indicated by a blackish stria, obtusely angulated and interrupted in disc, forming a triangular spot on dorsum; central fascia narrow, irregular, blackish, running from middle of costa to dorsum before tornus, dilated towards middle; an irregular blackish spot on costa about ⅘, whence a stria of blackish irroration runs through ocellus, margins of ocellus indicated by pale leaden-grey streaks; a small blackish apical spot, edged above and beneath by two white dots : cilia grey irrorated with white, and round apex with blackish. Hindwings with 3 and 4 stalked; grey, in disc and towards base thinly scaled; cilia light grey.

Q.: Cairns (Dodd); in November, one specimen.

53. ANCYLIS Hb.

Ancylis Hb., Verz. 376(1826)	... ...	type *lætana*.
Phoxopteris Tr., Schmett. Eur. vii., 232(1829)	...	type *lætana*.
Anchylopera Steph., Cat. Lep. 177 (1829)	...	type *lundana*.

Antennæ in ♂ shortly ciliated. Palpi moderately long, porrected, second joint with projecting scales above and beneath, terminal joint short or moderate. Thorax without crest. Forewings with apex falcate; 7 separate, to termen. Hindwings with 3 and 4 stalked or coincident, 5 approximated to 4, 6 and 7 closely approximated towards base.

A genus of no great extent, mainly characteristic of northern temperate regions.

340. *A. carpalima*, n.sp.

♂. *11 mm.* Head and thorax pale brownish-ochreous. Palpi whitish, towards base infuscated, second joint with long rough spreading hairs. Forewings elongate, rather narrow, costa gently arched, without fold, apex falcate, termen semicircularly excavated beneath it, somewhat oblique; ferruginous-ochreous irregularly mixed with whitish; costa obliquely strigulated with white and dark fuscous; dorsum dotted with blackish irroration; a rather broad suffused white median streak from base to beyond middle; central fascia indicated by an oblique dark spot from costa before middle; an irregular patch of dark fuscous irroration extending from disc beyond middle to near termen beneath apex; apical projection deep ferruginous, lower edge white margined with a fine black line and upper portion also edged anteriorly with black: cilia light ferruginous-ochreous. Hindwings with 3 absent, tornus rather prominent; rather dark grey; cilia light grey, tinged with ochreous round apex.

Q.: Cairns (Dodd); in October, one specimen. Also common in India and Ceylon.

54. HERPYSTIS, n.g.

Antennæ in ♂ ciliated. Palpi moderate, porrected, second joint rough-scaled above and beneath, terminal joint moderate. Thorax without crest. Forewings with 7 separate, to termen. Hindwings with 3 widely remote, parallel, 4 from angle, 5 approximated to 4 towards base, 6 and 7 closely approximated towards base.

Besides the following species, there is one from the Seychelles, and one in India.

341. *H. avida*, n.sp.

♂. 10 mm. Head, palpi, and thorax light grey, second joint of palpi with a dark grey median spot. Forewings elongate, costa gently arched, without fold, apex obtuse, termen faintly sinuate, somewhat oblique; grey irrorated with white, irregularly sprinkled and strigulated with blackish; costa and dorsum strigulated with white and blackish; outer edge of basal patch suffused with dark fuscous, angulated in middle; central fascia formed of dark fuscous suffusion, narrow, oblique, forming a subquadrate blackish spot on dorsum before tornus; margins of ocellus indicated by three or four small leaden-metallic spots; an apical patch of dark fuscous suffusion, extended along termen to near tornus: cilia grey mixed with white, on upper part of termen with a blackish subbasal line. Hindwings grey; cilia whitish-grey, with darker subbasal shade.

Q.: Cairns (Dodd); in March, one specimen, not in good condition.

55. EUCOSMA Hb.

Eucosma Hb., Zutr. Exot. Schmett. 28(1823) ... ... type *circulana*.
Epiblema Hb., Verz. 375(1826) ... ... type *fœnella*.
Cydia Hb., Verz. 375(1826) ... ... type *aspidiscana*.
Notocelia Hb., Verz. 380(1826) ... ... type *uddmanniana*.
Thiodia Hb., Verz. 391(1826) ... ... type *citrana*.
Pædisca Tr., Schmett. Eur. viii., 188(1830) type *solandriana*.
Crocidosema Zell., Is. x., 721(1847) ... type *plebeiana*.

Antennæ in ♂ ciliated. Palpi moderate, porrected, second joint with dense projecting scales above and beneath, terminal joint short. Thorax without crest. Forewings with 7 separate, to termen. Hindwings with 3 and 4 usually stalked, sometimes connate or coincident, 5 closely approximated at base, 6 and 7 closely approximated towards base.

A very large genus, but principally developed in Northern temperate regions and Africa. The generic synonyms quoted are only a selection from a very considerable number.

342. *E. brachyptycha*, n.sp.

♂. 18 mm. Head and thorax blackish. Abdomen elongate, rather dark grey, on posterior half with long lateral tufts of upcurved scales meeting over back. Forewings elongate-triangular, costa posteriorly gently arched, on basal fifth with a short erectile fold clothed with dense tuft of scales, apex obtuse, termen nearly straight, somewhat oblique; fuscous irregularly mixed with dark fuscous, more strongly and suffusedly on basal half of wing; roundish spots of black suffusion in disc before and beyond middle, and a larger irregular one beneath middle. Hindwings narrower than forewings, with dorsal fold, 3 and 4 connate; rather dark fuscous, veins darker; subdorsal area whitish-ochreous; cilia fuscous.

Q.: Cooktown (Meek); one specimen, in indifferent condition, but easily known by the structural characters. Also one from Ceylon, smaller (16 mm.), but otherwise similar.

343. *E. helota* Meyr.

(*Notocelia helota* Meyr., Journ. Bomb. Nat. Hist. Soc. xvi., 586.)

♂ ♀. 15-26 mm. Head and thorax dark fuscous. Forewing posteriorly dilated, costa in ♂ with moderate fold extending to middle; dark bronzy-fuscous, obscurely strigulated with leaden-grey; an ochreous-whitish discal dot at $\frac{2}{3}$. Hindwings in ♂ with dorsal fold filled with hairs; fuscous. Abdomen in ♂ towards apex densely hairy and with large anal tuft.

Q.: Mount Tambourine (Turner), in November; and I have also another specimen from Queensland, but without exact locality. Described from Ceylon, where it is a common species, and I have a specimen from Java.

344. *E. triangulana* Meyr.

(*Holocola triangulana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 670.)

Q.: Toowoomba (Turner)—N.S.W.: Sydney—Vic.: Gisborne, Macedon (Lyell), Melbourne (Raynor)—Tasm.: Hobart (Lyell), Launceston, George's Bay—S. Aust.: Adelaide—W. Aust.: Perth; from September to December. Larva cylindrical, whitish-grey, faintly purplish-tinged, head and plate of second segment ochreous-brown; feeds in a good deal of web and refuse amongst spun shoots of *Acacia decurrens*. Pupa in same position, without cocoon, furnished with a transverse row of small close oblique spines on each abdominal segment, stronger posteriorly. An unusually large ♀ specimen of the image (20 mm.) from Hobart is in Mr. Lyell's Collection.

345. *E. opsia*, n.sp.

♂ ♀. 14-16 mm. Head and thorax pale grey mixed with whitish, patagia suffused with light brown. Palpi white, second joint with base and two more or less defined bars dark fuscous, sometimes nearly obsolete. Forewings elongate, rather narrow, slightly dilated posteriorly, costa slightly arched, in ♂ with strong fold reaching from base to near ⅔, apex obtuse, termen nearly straight, somewhat oblique; grey or fuscous, suffused with brownish-ochreous, and finely sprinkled with white; costa strigulated with whitish suffusion, fold margined beneath with white suffusion; dorsum dotted with dark fuscous; two undefined oblique whitish marks or spots of suffusion above dorsum beyond middle; ocellus margined laterally by two leaden-metallic striæ; sometimes a white dot in disc at ¾, and some darker suffusion beneath it: cilia fuscous irrorated with white, base spotted with white on upper part of termen. Hindwings with 3 and 4 stalked; grey, thinly scaled near base, darker posteriorly; cilia whitish or pale grey, becoming wholly white round apex.

S. Aust.: Port Lincoln; in November, twenty specimens. Allied to *E. triangulana*, but lighter, and distinguished by the ochreous-brown suffusion, and absence of black markings.

346. *E. peræa*, n.sp

♀. 13 mm. Head, palpi, and thorax grey sprinkled with white, palpi rather long, white towards base. Forewings elongate, rather narrow, costa gently arched, apex round-pointed, termen somewhat sinuate, oblique; white, on costa with scattered oblique dark fuscous strigulæ, in disc with some longitudinal dark fuscous lines, on dorsal $\frac{2}{5}$ mostly suffused with rather dark fuscous, with several oblique transverse dark fuscous marks and spots on dorsal half; ocellus roundish, margined with silvery-metallic: cilia dark fuscous mixed with whitish. Hindwings with 3 and 4 stalked; grey-whitish, greyer-tinged posteriorly; cilia white.

Vic.: Sale; in September, one specimen, not in very good condition.

347. *E. plebeiana* Zell.

(*Crocidosema plebeiana* Zell., Meyr., Proc. Linn. Soc. N S. Wales, 1881, 659.)

Q.: Townsville (Dodd), Duaringa (Barnard), Brisbane, Stradbroke I. (Turner), Rosewood—N.S.W.: Glen Innes (3000 feet), Newcastle, Sydney, Bathurst, Cooma (3000 feet) —Vic: Gisborne, Macedon (Lyell), Birchip (Goudie), Kewell, Melbourne—S. Aust.: Mount Gambier (Guest), Mount Lofty, Port Lincoln—W. Aust.: Geraldton; from July to April. Larva on *Althæa* and *Lavatera*, doubtless introduced with these in gardens. The species occurs now in suitable localities throughout a large part of the globe.

348. *E. scopulosana* Meyr.

(*Bathrotoma* (?) *scopulosana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 677.)

N.S.W.: Sydney; in October.

349. *E. absconditana* Walk.

(*Sciaphila absconditana* Walk., Cat. xxviii., 351.)

♂ ♀. 16-20 mm. Head, palpi, and thorax ochreous-whitish more or less wholly suffused with brownish-ochreous or brownish. Forewings elongate, posteriorly dilated, costa moderately arched, in ♂ without fold, apex obtuse, termen sinuate, somewhat oblique; pale ochreous, sometimes sprinkled or strigulated with rather dark fuscous except towards dorsum, veins brownish or brownish-ochreous; basal patch with outer edge obtusely angulated below middle, in ♂ indicated only by a few dark fuscous scales, in ♀ with an irregular reddish-ochreous spot partially suffused with dark fuscous occupying angle or extended to dorsum; central fascia indistinct, straight, very slender, fuscous, sometimes little marked; a cloudy spot of fuscous suffusion towards apex; a black dot on costa before apex, and four or five on lower part of termen: cilia whitish-ochreous or pale ochreous, beneath tornus with a dark fuscous spot. Hindwings with 3 and 4 stalked; grey; cilia ochreous-whitish, with grey subbasal shade.

N.S.W.: Sydney; in September and October, five specimens.

350. *E. trepida*, n.sp.

♀. 12 mm. Head and thorax pale ochreous, face ochreous-whitish. Palpi light violet-fuscous, second joint with a pale ochreous band before apex, terminal joint rather long. Forewings elongate, posteriorly slightly dilated, costa gently arched, apex round-pointed, rather prominent, termen sinuate-concave, somewhat oblique; brownish-ochreous, strigulated throughout with dark fuscous; costa posteriorly with pairs of whitish strigulæ, from which in middle and at ¾ proceed two blue-leaden-metallic lines very obliquely outward to near termen, thence obtusely angulated and continued to form margins of ocellus, which is mostly occupied by three undefined spots of blackish irroration; a small dark fuscous spot at extreme apex, preceded by a leaden-metallic mark: cilia ochreous-greyish [imperfect], with dark leaden-fuscous basal line. Hindwings with 3 and 4 stalked; fuscous, anteriorly thinly scaled, veins darker; cilia whitish-fuscous, with fuscous subbasal shade.

Q.: Cairns (Dodd); one specimen. Type in Coll. Lower.

351. *E. pervicax*, n.sp.

♂♀. 16-18 mm. Head and thorax whitish-ochreous, crown and thorax speckled in ♂ with grey, in ♀ with red-brownish. Palpi ochreous-whitish, in ♂ sprinkled with dark grey. Forewings elongate, moderate, costa gently arched, in ♂ without fold, apex obtuse, termen sinuate-indented, little oblique: ochreous-brownish, in ♂ sprinkled with dark grey, in ♀ tinged with red-brownish towards costa anteriorly; costa strigulated with dark fuscous, interspaces more or less whitish, especially in ♂ posteriorly; a broad very undefined streak of dark fuscous irroration and strigulation above middle from near base to near termen, in ♀ more reddish-brown posteriorly; several leaden-metallic strigulæ on costa posteriorly, of which one from middle is extended as an oblique leaden-metallic line to ocellus, and another from before $\frac{3}{4}$ to termen beneath apex; ocellus suffused with white and margined with silvery-metallic, containing from two to four short black dashes towards posterior edge: cilia dark fuscous closely irrorated with ochreous-whitish. Hindwings with 3 and 4 short-stalked; rather dark fuscous, in ♂ lighter anteriorly; cilia grey irrorated with whitish, with dark grey subbasal shade.

N. Aust.: Port Darwin (Dodd); two specimens.

56. Procoronis, n.g.

Antennæ in ♂ simple. Palpi moderate, ascending, second joint shortly rough-scaled anteriorly, terminal joint short. Thorax without crest. Forewings with 7 separate, to costa. Hindwings with 3 and 4 connate, 5 closely approximated at base, 6 and 7 closely approximated towards base.

Type *P. rhothias*. There is no costal fold in this or any of the following genera.

352. *P. callirrhoa*, n.sp.

♂. 17 mm. Head brownish-ochreous. Palpi ochreous suffused with whitish, second joint with a fuscous spot above middle. Thorax greyish-ochreous. Forewings elongate, rather narrow, somewhat dilated posteriorly, costa slightly arched, apex rounded-obtuse, termen abruptly sinuate-indented, hardly oblique; greyish-ochreous, more or less mixed with whitish suffusion, especially on margin of markings; costal edge dark fuscous with pairs of oblique white strigulæ, from one of which in middle a white line runs beneath costa to apex, preceded by two or three short black dashes on veins; a moderately broad brownish-ochreous streak from base above middle to apex, sinuate downwards on posterior half, and containing some small spots of dark fuscous suffsion posteriorly; a broad rather dark fuscous streak along dorsum from base to tornus, attenuated at base, upper edge with two slight prominences before middle and two others at tornus, its posterior extremity surrounded with bluish-silvery suffusion: four or five undefined blackish dots or minute dashes before termen: cilia pale greyish-ochreous mixed with bluish-silvery-whitish, round apex reddish-ochreous. Hindwings dark fuscous, thinly scaled, with a broad darker terminal fascia; cilia dark grey, outer half whitish.

New Guinea: Sudest I. (Meek); two specimens.

353. *P. rhothias*, n.sp.

♂ ♀. 28-32 mm. Head and thorax pale ochreous variably suffused with brownish-ochreous, in one specimen crown and centre of thorax rather dark fuscous and patagia whitish-ochreous. Palpi ochreous-whitish, base of terminal joint and a subapical ring of second more or less fuscous or dark fuscous. Forewings elongate, somewhat dilated posteriorly, costa gently arched, apex obtuse, termen abruptly excised beneath apex, little oblique; in ♂ whitish-ochreous more or less obscurely streaked longitudinally with light brownish-ochreous or greyish-ochreous suffusion, in ♀ ochreous-brown; costa except near base dark fuscous with short ochreous-whitish strigulæ; edge of basal patch more or less indicated on lower half by undefined fuscous or dark brown suffusion; an irregular transverse more or less interrupted dark fuscous spot in disc beyond middle, in one pale ♂ obsolete; costal area more or less suffused with dark brown on posterior half, sometimes marked with ochreous-whitish and blackish streaks; dorsum sometimes suffused with dark fuscous, in one ♂ a broad dark fuscous streak along dorsum, contrasted with pale whitish-ochreous remainder of wing; sometimes two or three blackish dots towards termen below middle: cilia whitish-ochreous or pale ochreous, above apex brown, beneath tornus with a blackish spot. Hindwings dark fuscous; cilia greyish, with dark fuscous subbasal shade.

SOLOMON IS.; Guadalcanar, New Georgia, Choiseul (Meek)—NEW GUINEA; Sariba I. (Meek)—MOLUCCAS; Mangola (Doherty); seven specimens. Very variable, but easy of recognition.

57. BACTRA Steph.

Aphelia Steph., Cat. Brit. Ins. 180 (1829) (praeocc.) .... type *lanceolana*.
Bactra Steph., Ill. Brit. Ent. iv., 124 (1834) .... type *lanceolana*.

Antennæ in ♂ ciliated. Palpi moderate or long, porrected, second joint with projecting scales above and beneath, terminal short. Thorax without crest. Forewings with 7 separate, to termen. Hindwings with 3, 4, 5 closely approximated at base, 6 and 7 stalked.

This genus, formerly regarded as represented throughout most of the world by one very variable species, is now recognised as consisting of a considerable number of closely allied and generally similar species. These would often be very difficult to separate by the markings of forewings; but the shape of the forewings, the length of the palpi (usually somewhat longer in ♀ than in ♂), and sometimes the colour of hindwings give reliable characters, and the species so defined are found to be superficially and geographically consistent. Probably most or all are attached to rushes (*Juncus*) or allied plants. Collectors have usually neglected the group, on the supposition that they were dealing with a well-known cosmopolitan species, and good series of the different forms are much needed. The true *lanceolana* Hb., does not occur in the Oriental or Australian regions.

354. *B. phaulopa*, n.sp.

♂. 12 mm. Head, palpi, and thorax light brownish-ochreous, palpi 2¼. Antennal ciliations minute. Forewings elongate, costa gently arched, apex obtuse, termen slightly sinuate, oblique; light brownish-ochreous, irregularly sprinkled with dark fuscous; costa and dorsum strigulated with dark fuscous; some undefined dark fuscous suffusion along lower margin of cell from near base to its posterior extremity; a dark fuscous terminal line: cilia pale brownish-ochreous, slightly sprinkled with grey. Hindwings rather dark grey; cilia whitish-grey.

New Guinea; Kei Is.; one specimen.

355. *B. optanias*, n.sp.

♂ ♀. 15-21 mm. Head and thorax whitish-ochreous or brownish-ochreous. Palpi 2¼-2½, ochreous-whitish, somewhat mixed with dark fuscous. Antennal ciliations in ♂ ⅔. Forewings elongate, in ♀ rather narrow, posteriorly slightly dilated, costa gently arched, apex obtuse, termen almost straight, rather oblique; ochreous-brown or pale brownish, more or less mixed and suffused with ferruginous-ochreous, veins posteriorly usually with darker lines, in ♂ more or less wholly irrorated with dark grey or fuscous; costa and dorsum shortly strigulated with dark fuscous; a more or less indicated broad median streak of darker suffusion from base to apex, in ♂ margined above by a white streak except towards apex, often marked with a round dark fuscous spot at ⅓, an elongate dark fuscous or blackish mark beyond middle, and a dark fuscous or blackish streak towards apex, but these are sometimes obsolete; a narrow ocellus margined by two leaden-metallic streaks, outer contined as a strongly curved leaden-metallic stria to costa at ¾, in ♀ both sometimes obsolete: cilia whitish-ochreous or pale ochreous, more or less sprinkled with dark fuscous. Hindwings in ♂ light grey, in ♀ whitish-grey, veins grey; cilia grey-whitish, with light grey subbasal line.

Q.: Cooktown (Meek), Stanthorpe (Turner)—N.S.W.: Sydney—Vic: Melbourne (Raynor): from December to February, eight specimens. Also occurs in New Zealand, and is probably widely distributed in Australia.

356. *B. scythropa*, n.sp.

♀. 17 mm. Head and thorax brownish-ochreous. Palpi 1¾, pale ochreous irrorated with fuscous, terminal joint dark fuscous. Forewings elongate, posteriorly dilated, costa gently arched, apex obtuse, termen hardly sinuate, rather oblique; brown, veins posteriorly lined with dark fuscous; costa and dorsum shortly strigulated with dark fuscous; a roundish submedian spot of dark fuscous suffusion at ⅓, another less marked beyond lower angle of cell, and a triangular patch resting on termen beneath apex; a dark fuscous line along termen. Hindwings rather light fuscous, veins darker: cilia whitish-fuscous, with fuscous subbasal line.

Timor; Dilli (Doherty); in May, one specimen.

357. *B. phæopis*, n.sp.

♂ ♀. 11-14 mm. Head and thorax in ♂ ochreous-whitish tinged with brownish, in ♀ brownish. Palpi 1⅔-2, dark fuscous, apex of second joint whitish. Antennal ciliations in ♂ ⅓. Forewings elongate, posteriorly hardly dilated, costa slightly arched, apex obtuse, termen slightly rounded, oblique; in ♂ pale whitish-brownish, in ♀ light ochreous-brown, more or less sprinkled or strigulated with dark fuscous, and veins posteriorly lined with dark fuscous; costa obliquely strigulated with dark fuscous, alternating with ochreous-whitish; a roundish spot suffusedly outlined with dark fuscous in disc before middle, and an undefined elongate mark of dark fuscous suffusion in disc about ⅔; a dark fuscous line along termen: cilia greyish with several dark fuscous lines and rows of whitish points. Hindwings grey, lighter towards base; cilia pale grey, with darker subbasal shade.

New Guinea; Sudest I. (Meek); two specimens.

358. *B. blepharopis*, n.sp.

♂♀. 14-15 mm. Head and thorax ochreous-whitish. Palpi 2¼-2½, whitish, second joint with rather long rough hairs, with a blackish median spot. Antennal ciliations in ♂ ⅓. Forewings elongate, posteriorly slightly dilated, costa slightly arched, apex obtuse, termen slightly rounded, oblique; pale whitish-ochreous, with a few scattered dark fuscous scales and strigulæ; costa and dorsum shortly strigulated with blackish; a roundish submedian spot of blackish irroration before middle, and another more irregular and less strongly marked at ⅔: an undefined patch of dark fuscous suffusion on upper part of termen; a blackish line along termen: cilia dark fuscous irrorated with whitish, on tornus suffused with whitish. Hindwings grey, lighter towards base: cilia grey-whitish with grey subbasal shade.

Q.: Duaringa (Barnard), Brisbane (Turner); in April and May, three specimens.

359. *B. scalopias*, n.sp.

♀. 11 mm. Head pale grey. Palpi 2, ochreous-whitish suffused with light grey. Thorax whitish-ochreous suffused with light grey. Forewings elongate, rather narrow, costa gently arched, apex obtuse, termen straight, oblique; bronzy-fuscous, sprinkled with dark fuscous, with suffused irregular leaden-grey striæ, more distinct posteriorly, two of these enclosing ocellus; costa strigulated with whitish; veins posteriorly dark-lined: cilia grey irrorated with whitish points, with three blackish-grey lines. Hindwings whitish-grey; cilia grey-whitish.

N. Aust.: Port Darwin (Dodd); one specimen. It may be noted that, in this genus, the hindwings of the ♀ tend to be paler than those of the ♂, which is contrary to the prevailing rule.

58. POLYCHROSIS RAG.

Polychrosis Rag., Ann. Soc. Ent. Fr. lxiii., 209 (1894).. type *botrana*.
Syntozyga Low., Trans. Roy. Soc. S. Austr. xxv., 70 (1901)........................ type *psammetalla*.
Byrsoptera Low., Trans. Roy. Soc. S. Austr. xxv., 77 (1901)........................ type *xylistis*.

Antennæ in ♂ ciliated. Palpi moderately long, porrected, second joint rough-scaled above and beneath. Thorax with crest. Forewings with 7 separate, to termen. Hindwings with 3, 4, 5 more or less remote, 6 and 7 connate or stalked.

A genus of some extent, widely distributed in Asia, Europe, and Africa, probably of Indo-Malayan origin.

360. *P. botrana* Schiff.

(*Eudemis botrana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 649; *Grapholita parvulana* Walk., Cat. xxviii., 391.)

Q.: Brisbane (Turner), Rosewood—N.S.W.: Sydney; from March to September, and in November. Larva in spun shoots of the grape-vine, with which it has been introduced; occurs now commonly in Europe, Africa, and N. America.

361. *P. xylistis* Low.

(*Byrsoptera xylistis* Low., Trans. Roy. Soc. S. Austr. 1901, 77.)

Q.: Townsville (Dodd), Mackay, Cooktown (Lower); in November. Specimens received from Mr. Dodd are stated to have been bred, but without particulars.

362. *P. sedifera*, n.sp.

♂. 11-13 mm. Head, palpi, and thorax ochreous-whitish, palpi subascending, second joint more or less mixed with dark fuscous towards middle. Antennal ciliations 1. Forewings elongate, posteriorly dilated, costa gently arched, apex obtuse, termen straight, somewhat oblique; greyish-ochreous, groundcolour mostly obliterated by suffused subconfluent whitish striæ rising from pairs of costal strigulæ, costa dark fuscous between these; basal patch strigulated with grey, outer edge obtusely angulated in middle, lower portion formed by an acute-triangular patch marked with dark fuscous strigæ; central fascia greyish-ochreous more or less sprinkled and edged with dark fuscous, hardly oblique, somewhat curved, entire, outer edge with an acute projection at ¼ and a long narrow projection below middle; a subtriangular greyish-ochreous spot mixed with dark fuscous on dorsum before tornus, round which are some indistinct pale leaden-metallic streaks representing ocellus; a greyish-ochreous streak more or less mixed with dark fuscous from costa at ⅔ to middle of termen, slender on upper third, rest dilated, preceded and followed by pale leaden-metallic strigæ; a dark fuscous spot at apex; cilia whitish, with dark fuscous basal line. Hindwings grey; cilia grey-whitish, with dark grey subbasal line.

Q.: Cairns (Dodd), Brisbane, Gympie (Turner); from February to April, four specimens. This and the following species are nearly allied to the Indian *P. ephippias* Meyr.

363. *P. anconia*, n.sp.

♂. 12-14 mm. Head, palpi, and thorax ochreous-whitish, palpi porrected, second joint with a median spot of fuscous suffusion, thorax somewhat sprinkled with fuscous. Antennæ serrulate, simple. Forewings elongate-triangular, costa moderately arched, apex obtuse, termen straight, somewhat oblique; light greyish-ochreous; costa dark fuscous, with pairs of whitish strigulæ whence arise subconfluent glossy ochreous-whitish striæ obliterating nearly all groundcolour; markings more or less suffused with deeper ochreous and sprinkled or strigulated with dark fuscous; a moderate basal patch, its outer edge obtusely angulated in middle, with a more or less marked prominence above this, and sinuate inwards on lower half; central fascia interrupted below middle, upper half rather narrow, oblique, its posterior edge obtusely angulated in middle and with a narrow rather strong prominence at extremity, lower portion forming a blotch extending nearly along posterior half of dorsum, its upper side angularly emarginate and two upper angles projecting; a streak from ⅔ of costa to middle of termen, upper half very slender, lower dilated; two strigæ from costa to termen above this, first leaden-metallic on lower half; a small apical spot; indications of leaden-metallic strigæ about ocellus: cilia ochreous-whitish, with two fuscous shades becoming dark fuscous at apex and obsolete towards tornus. Hindwings grey; cilia grey-whitish, with grey basal shade.

Q.: Brisbane, Toowoomba (Turner); in March and April, five specimens.

364. *P. psammetalla* Low.

(*Syntozyga psammetalla* Low., Trans. Roy. Soc. S. Austr. 1901, 70.)

Q.: Townsville (Dodd), Duaringa (Barnard), Cooktown (Lower); in December and January.

59. Lobesia Guén.

Lobesia Guén., Eur. Micr. Ind. 59 (1845)... type *permixtana.*
Lomaschiza Low., Trans. Roy. Soc. S.
Austr. xxv., 68 (1901)...................... type *physophora.*

Antennæ in ♂ simple. Palpi moderate, porrected, second joint with rough projecting scales above and beneath, terminal joint short. Thorax with bifid crest. Forewings with 7 separate, to termen, 8 and 9 approximated, 10 and 11 approximated. Hindwings with 3 and 4 closely approximated at base, 5 approximated, 6 and 7 closely approximated towards base.

A very small genus, but represented in Europe, Asia, and Africa, as well as Australia, by nearly allied species.

365. *L. physophora* Low.

(*Lomaschiza physophora* Low., Trans. Roy. Soc. S. Austr. 1901, 69.)

Q.: Townsville (Dodd), Cooktown, Mackay (Lower); in June and July.

60. STERIPHOTIS, n.g.

Antennæ in ♂ simple. Palpi moderate, porrected, second joint with projecting scales above and beneath, terminal joint short. Thorax with bifid crest. Forewings with 7 and 8 in ♂ stalked, in ♀ approximated at base, 7 to termen, 9 closely approximated, 10 nearer 11 than 9. Hindwings with 3 and 4 connate, 5 absent, 6 and 7 stalked.

Type *S. peltophora* Meyr.

366. *S. peltophora*, n.sp.

♂ ♀. 12-13 mm. Head light fuscous. Palpi fuscous mixed with dark fuscous, tip whitish. Thorax light fuscous sprinkled with white, anteriorly and posteriorly mixed with dark fuscous and blackish. Forewings elongate, posteriorly dilated, costa hardly arched, apex obtuse, termen slightly rounded, somewhat oblique: whitish-fuscous with bluish-violet iridescence, with some scattered dark fuscous strigulæ; costa and dorsum strigulated with dark fuscous, costa with pairs of whitish strigulæ: markings brown partially edged and marked with black; a narrow basal fascia, widest on dorsum; a straight slightly oblique transverse streak about ⅓, hardly reaching dorsum, less developed in ♂; central fascia well-marked, little oblique, moderate, narrowed towards costa, posterior edge prominent or angulated in middle; a small spot on costa at ⅔, and one at apex; a rounded blotch before termen in middle, connected with middle of termen, and with a suffused striga or undefined branch running to tornus: cilia fuscous with obscure indications of violet-whitish bars. Hindwings fuscous, thinly scaled towards base, darker posteriorly and on veins; cilia whitish-fuscous, with fuscous subbasal line.

Q.: Brisbane (Turner); from January to March, three specimens.

367. *S. extrusana* Walk.

(*Grapholita extrusana* Walk., Cat. xxviii., 392.)

♀. 16 mm. Head, palpi, and thorax fuscous, thorax dorsally suffused with dark fuscous. Forewings elongate, posteriorly dilated, costa hardly arched, apex obtuse, termen slightly rounded, somewhat oblique; pale fuscous, with scattered dark fuscous scales and strigulæ; costa and dorsum shortly strigulated wth dark fuscous; basal patch slightly darker, forming a suffused dark fuscous spot on dorsum towards base, outer edge angulated near costa; a strongly curved anteriorly convex blackish-fuscous streak rising from dorsum beyond middle, extending $\frac{2}{3}$ across wing, its extremity strongly curved over posteriorly; a small slightly darker spot on middle of costa; a large fuscous apical patch, becoming darker fuscous anteriorly, its edge running from $\frac{2}{3}$ of costa to tornus, including two pairs of whitish costal strigulæ, a whitish dot on termen above middle, and some indistinct pale marking towards apex: cilia rather dark fuscous, with rows of whitish points. Hindwings rather dark fuscous, thinly scaled towards base, darker posteriorly; cilia whitish-fuscous, with darker subbasal line.

Q.: Brisbane (Lucas); one specimen. Walker's type was from the same district.

61. PROSCHISTIS Meyr.

Proschistis Meyr., Journ. Bomb. Nat. Hist. Soc. xvii., 731(1907)...................................... type *zaleuta*.

Antennæ in ♂ ciliated. Palpi moderate, porrected, second joint with rough projecting scales above and beneath, terminal joint moderate. Thorax with small crest. Forewings with 7 and 8 separate, 7 to termen. Hindwings with 3, 4, 5 approximated at base, 6 and 7 approximated towards base.

Represented at present by several Indian species.

368. *P. actæa*, n.sp.

♂♀. 17-24 mm. Head and thorax ochreous-brownish or pale ochreous. Palpi pale ochreous, second joint with three small dark fuscous spots. Antennal ciliations in ♂ $\frac{1}{3}$. Forewings moderate, rather dilated posteriorly, costa moderately arched, apex obtuse, termen slightly sinuate, vertical; ferruginous-ochreous-brown, usually paler towards costa anteriorly, in ♀ sometimes suffused with pale ochreous on basal half; costal edge dark fuscous with pairs of pale ochreous strigulæ on anterior half and whitish strigulæ on posterior half; a rather narrow fascia of deeper ferruginous-brown suffusion, posterior edge sharply defined, white-margined, running from middle of costa to dorsum near tornus, followed by a broad band of whitish suffusion; an irregular elongate ferruginous-brown patch lying between this and an oblique leaden-metallic stria from costa, resting on middle of termen; ocellus small, whitish, obscurely edged with pale silvery-metallic, and marked with three short brown dashes mixed with dark fuscous; apex dark ferruginous-brown: cilia ochreous-whitish, more ochreous-tinged posteriorly, above apex dark fuscous, in middle of termen with a brown bar. Hindwings grey, obscurely darker-strigulated posteriorly; cilia whitish-grey, with subbasal line.

Solomon Is.: Choiseul, Isabel I. (Meek); nine specimens.

62. Anathamna, n.g.

Antennæ in ♂ simple. Palpi moderate, porrected, second joint rough-scaled above and beneath, terminal joint short or moderate. Thorax with small crest. Forewings with 7 and 8 stalked, 7 to termen. Hindwings with 3, 4, 5 approximated at base, 6 and 7 closely approximated towards base.

Type *A. ostracitis* Meyr. This genus is undoubtedly in its right position here, but the peculiar form of wing gives a superficial resemblance to some of the typical *Tortricidæ*, which is supported to some extent by the colouring.

369. *A. plana*, n.sp.

♂ ♀. 16-19 mm. Head and thorax brownish-ochreous. Palpi whitish-yellowish, second joint suffused with pale violet-fuscous towards apex. Forewings oblong, costa anteriorly moderately, posteriorly slightly arched, apex obtuse, termen hardly sinuate, vertical; brownish-ochreous, with faint lilac reflections; costa obliquely strigulated with dark fuscous and ochreous-whitish; lower half of an oblique central fascia represented by slightly darker brownish suffusion; a slightly darker very oblique streak edged with ochreous-whitish from costa beyond middle to termen above middle, where it forms a small dark fuscous spot: cilia pale ochreous. Hindwings rather dark grey; cilia grey-whitish, basal half grey.

N. AUST.: Port Darwin (Dodd); three specimens. Very close to *A. ostracitis*, but certainly distinct by the different shape of wing, the costa being less arched anteriorly, and slightly arched instead of sinuate posteriorly; further the face is not darker than the head, and the palpi are much paler-coloured.

370. *A. ostracitis*, n.sp.

♂♀. 16-18 mm. Head and thorax brown, face darker. Palpi dark iridescent violet-fuscous, whitish towards base beneath, second joint with median spot in ♂ yellowish, in ♀ ochreous-whitish, terminal joint whitish towards apex. Forewings oblong, costa anteriorly strongly arched, posteriorly slightly sinuate, apex obtuse, termen slightly sinuate, vertical; brownish-ochreous, more or less suffused with brownish on dorsal half; costa dark fuscous obliquely strigulated with whitish-ochreous; some undefined fuscous suffusion towards dorsum before middle, and an undefined transverse blotch of fuscous suffusion resting on dorsum about ¾; apical area ochreous-brownish, crossed by two very oblique pale partially leaden-metallic striæ from costa, between which is a small darker brown spot on termen above middle: cilia pale ochreous, towards tips whitish. Hindwings dark grey; cilia ochreous-whitish, suffused with grey towards base.

NEW GUINEA: Sudest I. (Meek); five specimens.

371. *A. syringias*, n.sp.

♀. 20 mm. Head and thorax pale ochreous. Palpi whitish-ochreous, second joint with a fuscous bar. Forewings oblong, costa anteriorly strongly arched, posteriorly slightly sinuate, apex obtuse, termen faintly sinuate, vertical; light brownish, suffusedly mixed with whitish-ochreous; costal edge dark fuscous obliquely strigulated with ochreous-whitish, with a brown subcostal streak from before middle to near apex; a brown median streak from base to near termen, anteriorly rather sinuate upwards, beneath prominent beyond middle; a broad brown dorsal streak from base to near tornus, narrowed posteriorly, upper edge somewhat prominent in middle; a curved brown streak from beneath costa at ¾ to middle of termen; a small brown elongate spot above tornus: cilia pale ochreous, towards tips whitish. Hindwings fuscous; cilia pale ochreous, outer half ochreous-whitish.

SOLOMON IS.: Choiseul (Meek); one specimen.

63. HELICTOPHANES Meyr.

Helictophanes Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 637 .... type *uberana.*

Antennæ in ♂ ciliated. Palpi moderate, porrected, second joint with rough projecting hairs above and beneath, terminal joint moderate. Thorax with bifid crest. Forewings with 7 and 8 separate, 7 to costa. Hindwings with 3 and 4 stalked, 5 approximated at base, 6 and 7 stalked.

Now restricted to the single species.

32. *H. uberana* Meyr.

(*Helictophanes uberana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 639.)

N.S.W.: Sydney; from August to December.

64. ARGYROPLOCE Hb.

Argyroploce Hb., Verz. 379 (1826)..............type *arbutella.*

Penthina Tr., Schmett. Eur. vii., 227 (1829)...type *salicella.*

Antithesia Steph., Cat. Brit. Ins. 172 (1829)...type *corticana.*

Temnolopha Low., Trans. Roy. Soc. S. Austr. 1901, 72 ....type *mosaica.*

Sorolopha, Low., Trans. Roy. Soc. S. Austr. 1901, 73 ....type *cyclotoma.*

Acanthothyspoda Low., Trans. Roy. Soc. S. Austr. 1908, 319.....................................type *eleodes*

Antennæ in ♂ simple or shortly ciliated. Palpi moderate, porrected or more or less ascending, second joint with more or less projecting scales above and beneath, terminal joint short or moderate. Thorax with posterior crest. Forewings with 7 and 8 separate, 7 to termen. Hindwings with 3 and 4 connate or seldom stalked, 5 approximated at base, 6 and 7 closely approximated towards base.

The genus is a very large one, but especially characteristic of the northern hemisphere; it is hardly represented in the true Australian fauna (only by the two quite peculiar species *A. endophaga* and *A. gonomela*), but forms a prominent feature in the Indo-Malayan element which enters by way of Northern Queensland. The males of many species show curious folds and lobes in the hindwings, or tufts on the posterior legs. There is an extensive array of further generic synonyms, which need not be quoted here.

373. *A. iridosoma*, n.sp.

♂. 14-16 mm. Head, palpi, and thorax light pinkish-fuscous sprinkled with whitish. Abdomen dorsally with long pale greyish-ochreous hairs, with very large anal tuft of pale greyish-ochreous hairs with violet-purplish iridescence. Posterior tibiæ and basal portion of tarsi with dense expansible brush above of very long whitish-ochreous hairs somewhat mixed with dark fuscous. Forewings triangular, costa gently arched, apex rounded-obtuse, termen hardly sinuate, rather oblique; light brownish closely irrorated with ochreous-whitish, with lilac iridescence; some scattered dots or strigulæ of blackish-fuscous scales, arranged in irregular transverse series, or sometimes disc largely suffused with rather dark fuscous; a small triangular blackish-fuscous spot on dorsum before tornus: cilia pinkish-fuscous sprinkled with whitish. Hindwings reduced, narrower than forewings, above with subdorsal ridge terminating in a glandular swelling, beneath with dorsum recurved and enclosing dense tuft of hairs towards tornus; purplish-fuscous, becoming darker towards dorsum; cilia light grey.

Q.: Brisbane (Turner); in December, two specimens. Much smaller than *A. illepida*, forewings shorter and relatively broader; the glandular swelling near tornus of hindwings is a peculiar structural character.

374. *A illepida* Butl.

(*Teras illepida* Butl., Trans. Ent. Soc. Lond 1882, 42; *Arotrophora ombrodelta* Low., Proc. Linn. Soc. N. S. Wales 1898, 48; *Cryptophlebia carpophaga* Wals., Ind. Mus. Not. iv., 106, pl. vii.,1).

N. Aust.: Port Darwin (Bleeser) – Q.: Townsville (Dodd), Duaringa (Barnard), Brisbane (Turner), Toowoomba N.S.W.: Richmond R. (Lyell); in June, August, November, December, and March, probably most of the year. Larva in pods of *Acacia* and *Cassia*. The species occurs widely in India, Ceylon, S. Africa, and the Hawaiian Islands, but has probably been introduced with its foodplants; its home may be India.

375. *A. zelantha*, n.sp.

♀. 16 mm. Head, palpi, and thorax deep ferruginous, palpi subascending. Forewings moderate, posteriorly dilated, costa moderately arched, apex rounded-obtuse, termen rounded, little oblique; deep ferruginous-red; costa suffusedly strigulated with blackish; markings glossy blue-leaden, rising from pairs of minute whitish costal strigulæ; a spot on costa towards base; a fascia before middle, dilated on dorsum; a narrow irregular fascia from $\frac{3}{5}$ of costa to tornus, dilated on tornus, connected by a bar from below middle with preceding fascia on dorsum; two confluent streaks from costa posteriorly to termen beneath apex : cilia ferruginous-red, on upper part of termen with three pale bluish bars, on tornus mixed with dark fuscous. Hindwings dark fuscous, anteriorly fulvous-tinged; cilia pale fulvous-fuscous, with darker subbasal line

Solomon Is.: Choiseul (Meek); one specimen A very distinct and handsome species; although conveniently described as above, the ferruginous-red colouring really forms the usual basal patch and central fascia.

376. *A. immanis* Meyr.

(*Carpocapsa immanis* Meyr., Trans. Ent. Soc. Lond. 1886, 275).

Fiji (Lucas). No further examples seen.

377. *A. pachnodes*, n.sp.

♀. 19-23 mm. Head and thorax dark fuscous mixed with brownish, forehead sometimes marked with ochreous, shoulders with indigo-blue reflections. Palpi porrected, yellowish, spotted with indigo-blackish. Forewings moderately broad, posteriorly dilated, costa slightly arched, faintly sinuate in middle, apex obtuse, termen rounded, somewhat oblique; rather dark fuscous, costa tinged with crimson; basal patch irregularly suffused with blackish-fuscous and spotted with leaden-metallic, outer edge curved, followed by two subconfluent striæ of rough leaden-metallic scales; central fascia broad, undefined, formed of irregular blackish-fuscous suffusion strewn with spots of rough leaden-metallic scales, and marked with two or three short ochreous-whitish dashes above middle; costa posteriorly with several small blackish-fuscous spots, edge ochreous-whitish between these; an irregular rough leaden-metallic oblique stria towards apex, two or three leaden-metallic dots and blackish-fuscous strigulæ above it, a blackish-fuscous streak beneath it from near costa to middle of termen, and a double rough leaden-metallic streak marking posterior edge of ocellus: cilia leaden-fuscous mixed with blackish-fuscous. Hindwings dark fuscous; cilia whitish, with dark fuscous subbasal line.

SOLOMON IS.: New Georgia, Isabel I. (Meek)—NEW GUINEA: Fergusson I. (Meek); in December, three specimens. The roughened leaden-metallic markings are a peculiar feature.

378. *A. crossota*, n.sp.

♂. 18-19 mm. Head and thorax light greyish-ochreous, somewhat spotted with dark fuscous. Palpi porrected, pale ochreous, spotted with dark fuscous. Abdomen rather elongate. Posterior tibiæ clothed with dense pale ochreous scales. Forewings moderate, posteriorly dilated, costa slightly arched, sinuate in middle, apex obtuse, termen hardly sinuate, somewhat oblique; 7 and 8 closely approximated near base; pale ochreous or whitish-fuscous, partially brownish-tinged, somewhat strigulated with fuscous or brownish; some dark fuscous strigulation towards base, and towards dorsum before middle; costa spotted with blackish, with a larger flattened-triangular black-brown spot in middle; an irregular patch of blackish irroration in disc at ⅘: cilia pale ochreous mixed with brownish and sprinkled with whitish. Hindwings with subdorsal fold; fuscous; cilia light fuscous, with darker subbasal line.

SOLOMON IS.: Bougainville (Meek)—NEW GUINEA: Aru Is. (Doherty); in October, two specimens.

379. *A. parasema*, n.sp.

♀. 19 mm. Head pale ochreous, crown tinged with fuscous. Palpi porrected, ochreous-yellowish, base of joints and a subapical bar of second joint blackish. Thorax pale ochreous, suffused with fuscous except shoulders and posterior extremity. Forewings elongate, moderate, posteriorly dilated, costa moderately arched, faintly sinuate in middle and rather prominent at ¾, apex very obtuse, termen almost straight, vertical; light brownish-ochreous, partially sprinkled with ferruginous; a blotch of irregular purplish-fuscous marbling occupying dorsal ¾ of wing from base to tornus, margins of cell partially marked with blackish and ferruginous scales, costal area above this sprinkled and strigulated with fuscous and dark fuscous; a small flattened-triangular dark fuscous spot on middle of costa: two purplish-leaden-fuscous oblique transverse streaks posteriorly, and between these a curved dark fuscous streak running to termen below middle, between apex of which and costal median spot are two blackish dashes on veins; three small suffused blackish spots on costa towards apex, beneath which is some coppery-purplish suffusion: cilia ochreous-yellowish, indistinctly barred with dark fuscous. Hindwings rather dark fuscous; cilia whitish-grey, with darker grey subbasal shade.

SOLOMON IS.: Choiseul (Meek); one specimen. Differs from the preceding in form of wing as well as in markings.

380. *A. sphærocosmana* Meyr.

(*Antithesia sphærocosmana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 642).

N.S.W.: Richmond River (Masters). No further examples seen.

381. *A. placida*, n.sp.

♂♀. 17-19 mm Head and thorax brown mixed with darker, sometimes tinged with ochreous or reddish. Palpi ascending, white, suffusedly spotted with red-brownish. Posterior tibiæ in ♂ densely tufted above with long white hairs. Forewings moderate, broadly dilated posteriorly, costa moderately arched, somewhat bent beyond middle, apex obtuse, termen almost straight, vertical; in ♂ brownish-ochreous, in ♀ brown; in ♂ basal patch ochreous-brown except towards costa, its edge angulated above middle, central fascia forming a brown costal spot and larger transverse dorsal blotch, latter suffusedly confluent with a triangular prætornal spot, in ♀ these markings rather darker reddish-fuscous but obscured by a general reddish-fuscous suffusion which extends from base to their posterior edge; a suffused triangular brown or reddish-fuscous apical blotch, enclosing two oblique leaden-metallic striæ before apex: cilia reddish-ochreous or reddish-fuscous mixed with leaden-grey, in ♂ paler on tornus. Hindwings rather dark grey; cilia grey-whitish or pale grey, sometimes reddish-tinged, with dark grey subbasal line.

Q.: Brisbane (Turner); in August, September, January, and April, four specimens.

382. *A. lamyra*, n.sp.

♂.17-18 mm ; ♀.14-15 mm. Head and thorax violet-grey more or less spotted with flesh-colour. Palpi porrected, ochreous-yellow, spotted with dark fuscous. Abdomen in ♂ elongate. Posterior tibiæ in ♂ with very long expansible tuft of grey hairs, coxæ with small expansible tuft of white scales. Forewings elongate-triangular, narrow at base, in ♂ greatly, in ♀ moderately dilated posteriorly, costa faintly sinuate in middle, arched posteriorly, more strongly in ♂, apex very obtuse, termen nearly straight, vertical; light crimson-rose, with some scattered blackish strigulæ; basal patch blackish except along costa, edged with yellowish and then with blue-leaden-metallic striæ beneath costa and posteriorly, in upper part of disc irregularly streaked with ochreous-yellow, near base with one or two violet-blue spots, marginal blue-leaden stria doubled on lower portion; central fascia indicated by irregular blackish longitudinal markings edged posteriorly by a curved series of oval leaden-metallic spots, one above middle produced anteriorly into an elongate streak and edged with yellowish; four elongate blackish marks on costa posteriorly, last apical; an oblique leaden-metallic striga towards apex, and an irregular blackish streak beneath this; a series of four subconfluent leaden-metallic spots before lower portion of termen : cilia pale pinkish-grey, with several darker leaden-grey bars, tips whitish. Hindwings in ♂ very narrow, dorsal area separated to form a long pointed and thickened scaled lobe from base, with some long basal hairs and clothed with hairs beneath, tornal angle of remainder produced into a strong rounded-obtuse prominence with a strong indentation before it and a deep excavation beyond it, in ♀ wing smaller than usual, narrower than forewings; dark grey, towards base thinly scaled and in ♂ subhyaline; cilia whitish, with grey basal line.

New Guinea : Woodlark I., Sudest I. (Meek); six specimens.

383. *A. erotias* Meyr.

(*Platypeplus erotias* Meyr., Journ. Bomb. Nat. Hist. Soc. 1905, 585).

♂♀. 13-16 mm. Forewings rather short-triangular, brown suffused with rosy-crimson especially on margins, strigulated with dark fuscous and strewn with spots of raised leaden scales; a small whitish-ochreous discal spot at ⅔. Hindwings dark fuscous, in ♂ with subdorsal groove and curled tornal cilia.

New Guinea : Kei Is.—Timor : Dilli (Doherty); in February and May. Also occurs in India and Ceylon.

384. *A. inodes*, n.sp.

♀. 18 mm. Head and thorax reddish-brown irregularly mixed with ochreous-whitish. Palpi subascending, ochreous-whitish, spotted with reddish brown and blackish. Forewings broad, costa strongly arched, apex very obtuse, termen slightly rounded, rather prominent; pale brownish flesh-colour irregularly strigulated throughout with blue-leaden-metallic, with a few scattered dark fuscous strigulæ; markings formed by an irregular intermixture of whitish-ochreous, brown, and black marks, very undefined and irregular; basal patch with outer edge oblique; central fascia moderate, oblique, becoming broad downwards, including a small round ochreous-whitish spot within its posterior edge in middle; a streak from beneath costa at ¾ to middle of termen, above which is a blue-leaden stria: cilia whitish-ochreous, on upper half of termen barred with bluish grey, beneath tornus with a dark grey spot. Hindwings dark fuscous; cilia whitish, barred with grey, with dark grey basal line.

NEW GUINEA: Woodlark I. (Meek); one specimen.

385. *A. scaristis*, n.sp.

♂. 17 mm. Head dark fuscous spotted with whitish, lower half of face whitish. Palpi short, porrected, white spotted with dark fuscous. Thorax white irregularly marked with dark fuscous, with a few reddish scales. Pasterior tibiæ and basal joint of tarsi densely tufted above with long white scales. Forewings moderately broad, posteriorly dilated, costa gently arched, apex rounded-obtuse, termen almost straight, little oblique; rather dark fuscous; basal half almost wholly covered with suffused white striæ except a small round spot beneath costa towards base and a larger spot on costa beyond it; posterior half of costa with five pairs of white strigulæ; an undefined discal patch beyond middle suffusedly mixed with blackish, followed by two subconfluent oblique purplish-leaden striæ terminating in ocellus, with some scattered dark red scales round them; ocellus very broadly edged with leaden-metallic mixed with whitish, and bisected by a similar horizontal bar; two or three oblique confluent leaden-metallic whitish-mixed striæ across apex, extreme apex dark brown-red: cilia grey irrorated with white, with brown-reddish basal line. Hindwings with subdorsal fold clothed with hairs; dark grey; cilia white with dark grey subbasal line.

NEW GUINEA: Woodlark I. (Meek); one specimen.

386. *A. ergasima*, n.sp.

♂. 15 mm. Head and thorax ochreous-whitish irregularly mixed with fuscous and dark fuscous. Palpi short, porrected, ochreous-whitish suffusedly spotted with dark fuscous. Posterior tibiæ above with long expansible tuft of white hairs. Forewings moderate, posteriorly dilated, costa gently arched, apex obtuse, termen slightly rounded, hardly oblique; fuscous-whitish, with scattered grey, greenish-fuscous, and blackish strigulæ; basal patch strigulated with blackish and partially suffused with greenish-fuscous, especially on a costal posterior spot, outer edge obtusely angulated in middle; central fascia broad, very irregular-edged, greenish-fuscous, sprinkled with blackish, not reaching dorsum; irregular similarly-coloured costal patch beyond and almost confluent with this, connected with middle of termen by an irregular streak; ocellus elongate, mixed with greenish-fuscous and blackish irroration, edged with broad violet-whitish streaks mixed with pale leaden-metallic: cilia fuscous suffusedly barred with rather dark grey. Hindwings with subdorsal groove and dorsum clothed with long hairs, tornus forming a strong angular prominence; dark fuscous, rather thinly scaled anteriorly; cilia whitish-fuscous, with dark fuscous subbasal shade.

New Guinea: Woodlark I. (Meek); one specimen. Readily distinguished from species of similar appearance by the angular tornal prominence of hindwings.

387. *A. euplectra* Low.

(*Tortrix euplectra* Low., Trans. Roy. Soc. S. Austr. 1908, 322).

♂. 16 mm. Head and thorax whitish-ochreous suffused with light pinkish-fuscous, transversely barred with dark fuscous irroration (two bars on head, two on thorax, posterior of these not crossing patagia). Palpi subascending. Posterior tibiæ without tufts. Forewings moderate, rather dilated, costa gently arched, apex obtuse, termen rounded, somewhat oblique; whitish-ochreous, irregularly sprinkled and strigulated with dark grey; basal patch suffused with pale brownish, outer edge hardly curved; space between this and central fascia more ochreous-whitish, suffused with grey towards dorsum; central fascia brown irregularly marked with black, hardly oblique, narrow on costa and dorsal third, irregularly dilated posteriorly in disc, upper portion confluent with a patch of dark grey suffusion beneath costa following it and two small dark fuscous costal spots to form a conspicuous dark blotch; an erect brown tornal spot; a ring-shaped brown mark towards termen, connected by a bar with middle of termen; a small and blackish spot on costa near apex, and one at apex: cilia red-brown sprinkled with whitish and barred with dark grey. Hindwings rather dark fuscous; cilia fuscous-whitish, with dark fuscous subbasal line, and grey apical bar.

Q.: Cooktown (Meek), Brisbane (Lower); two specimens, including the type.

388. *A. helicana* Meyr.

(*Penthina helicana* Meyr., Proc. Linn. Soc., N. S. Wales, 1881, 645).

Q.: Duaringa (Barnard), Rosewood—N.S.W.: Richmond R. (Masters), Newcastle and Bulli; in September and October. The posterior tibiæ of ♂ are rough-scaled above.

389. *A. operosa*, n.sp.

♀. 19-23 mm. Head, palpi, and thorax fuscous, palpi porrected. Forewings elongate, moderate, posteriorly hardly dilated, costa moderately arched, apex obtuse, termen almost straight, vertical; light iridescent violet-fuscous; costa suffused with light brown on anterior half; a hardly oblique rather narrow brown fascia beyond middle, anteriorly suffused, posterior edge defined, angulated near costa and below middle, concave between these; posterior half of costa with four pairs of ochreous-whitish strigulæ, brown between these; a round violet-brown blotch towards termen above middle, anteriorly entered by a projecting bar of ground-colour, posteriorly connected by a bar with termen below middle; some fine scattered black dashes on veins posteriorly: cilia dark violet-fuscous irrorated with whitish. Hindwings dark fuscous, lighter anteriorly; cilia whitish-fuscous, with dark fuscous subbasal shade.

New Guinea: Woodlark I. (Meek); two specimens.

390. *A. cyclotoma* Low.

(*Sorolopha cyclotoma* Low., Trans. Roy. Soc. S Austr. 1901, 74).

Abdomen in ♂ with dorsal tuft of pale yellowish scales towards base, and with loose yellowish scales dorsally throughout, on sides with very large expansible tufts of long pale fuscous hairs from near base Posterior tibiæ yellowish on sides, in ♂ with dense expansible brush of whitish hairs above. Hindwings (described by Lower as golden-ochreous) dark fuscous, lighter anteriorly, on undersurface suffused with ochreous-yellow anteriorly.

Q.: Cairns, Townsville (Dodd); in November, and from February to April.

391. *A. mosaica* Low.

(*Temnolopha mosaica* Low., Trans. Roy. Soc. S. Austr. 1901, 72).

N. Austr.: Port Darwin—Q.: Townsville (Dodd); in January. Common also in India, Ceylon, and Siam.

392. *A. mesarotra*, n.sp.

♀. 15-17 mm. Head whitish, crown somewhat mixed with grey, face with a blackish bar Palpi porrected, whitish, second joint with three blackish spots. Thorax ochreous-whitish, mostly suffused with fuscous and dark fuscous except shoulders. Forewings moderate, posteriorly dilated, costa moderately arched, apex obtuse, termen hardly sinuate, scarcely oblique; pale greyish-ochreous, tips of scales silvery-whitish; markings olive-brownish, mixed and strigulated with black, margined with whitish-ochreous; costa slightly reddish-tinged, with some scattered dark fuscous strigulæ; basal patch represented by a longitudinal streak above middle and a triangular patch occupying basal third of dorsum; central fascia irregular, broad, not oblique, postmedian, interrupted below middle, and with posterior edge very deeply indented above middle, forming an acute projection between these; an irregular conical prætornal spot representing ocellus; a downward-oblique elongate mark terminating in middle of termen; a small dark fuscous apical spot: cilia fuscous sprinkled with whitish, with dark fuscous basal line, on tornus suffused with ochreous-whitish. Hindwings dark grey, thinly scaled anteriorly; cilia fuscous, with dark fuscous subbasal line.

SOLOMON IS.: Choiseul (Meek); two specimens.

393. *A. batrachodes*, n.sp.

♀ 18-19 mm. Head and thorax pale ochreous. Palpi porrected, ochreous-whitish, with two or three dark fuscous spots. Forewings moderate, posteriorly dilated, costa moderately arched, apex obtuse, termen slightly sinuate, vertical; whitish-ochreous; costa obliquely strigulated with dark fuscous; basal patch and dorsal half of wing to termen sometimes suffused with light brown; a short oblique dark brown streak from costa at ¼ margining basal patch, connected by a more or less indistinct streak of fuscous suffusion with an irregular patch of brown or fuscous suffusion on dorsum towards tornus; a small dark brown oblique spot on middle of costa; a rounded or rather elongate brown spot in disc at ⅔; a downward-oblique brown or dark fuscous streak terminating in middle of termen, upper part sometimes expanded into a patch of dark suffusion; a small dark brown apical spot edged with whitish in front and behind; ocellus sometimes containing two rather dark fuscous dashes: cilia pale ochreous-brownish, on upper half of termen paler or ochreous-whitish. Hindwings rather dark fuscous; cilia ochreous-whitish, with fuscous subbasal shade.

SOLOMON IS.: Treasury I (Meek) NEW GUINEA: Sudest I., St. Aignan I. (Meek) - Q.: Duaringa (Barnard); five specimens.

394. *A. doxasticana* Meyr.

(*Penthina doxasticana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 644).

Q.: Duaringa (Barnard), Mt. Tambourine (Turner), Brisbane—N.S.W.: Parramatta; from June to November. I have seen a variety in which the forewings are irregularly blotched with black.

395. *A. chionodelta*, n.sp.

♂. 15-16 mm. Head and palpi dark fuscous, palpi ascending. Thorax dark fuscous, more or less mixed with white posteriorly. Posterior tibiæ whitish-ochreous, shortly scaled above Forewings elongate, posteriorly dilated, costa gently arched, apex obtuse, termen straight, hardly oblique; brown, mixed with dark fuscous, with suffused leaden-metallic striæ rising from oblique white costal strigulæ; basal patch suffused with dark fuscous, extending on costa to ⅔, on dorsal half limited by a semioval white blotch extending along dorsum from ⅕ to ⅔ and reaching half across wing; central fascia suffused with dark fuscous, irregular, rather narrow on costa, broad in upper part of disc, narrow towards dorsum and adjoining the white dorsal blotch; a subquadrate white tornal blotch, upper posterior angle sending a conical projection near termen to near costa: cilia fuscous mixed with dark fuscous, with white tornal patch (imperfect). Hindwings with subdorsal fold, dorsal edge clothed with long hairs; fuscous; cilia fuscous-whitish, with fuscous subbasal shade.

Q.: Cairns (Dodd), Geraldton (Turner); in October and November, two specimens.

396. *A. aprobola* Meyr.

(*Eccopsis aprobola* Meyr., Trans. Ent. Soc. Lond. 1886, 275; *Temnolopha metallota* Low., Trans. Roy. Soc. S. Austr. 1901, 73).

New Guinea: Trobriand I. (Meek) - Q.: Duaringa (Barnard), Cooktown (Lower)—Tonga Is.: (Mathew); from April to June. Also occurs commonly in India, Ceylon, and the Seychelles, probably attached to some cultivated tree and introduced with it.

397. *A. trichograpta*, n.sp.

♂. 12-13 mm. Head, palpi, and thorax fuscous; palpi porrected, with an obscure yellowish median spot more or less indicated. Posterior tibiæ without tuft. Forewings elongate, hardly dilated, costa gently arched, apex obtuse, termen almost straight, hardly oblique; brownish; costa strigulated with dark fuscous, with pairs of very fine white costal strigulæ, especially four pairs towards middle; basal patch indicated by some darker strigulæ or suffusion, extending over ⅖ of wing, edged by a dark stria angulated above middle; an irregular suffused dark fuscous patch in disc beyond middle; ocellus obscurely edged with leaden-metallic, enclosing three or four black dots or minute dashes;

posterior part of costa and upper half of termen suffused with dark fuscous, with a stronger white costal strigula before apex, whence an indistinct whitish stria runs to termen below middle: cilia brownish with rows of whitish points, on tornus paler, beneath tornus with a dark fuscous spot. Hindwings grey, thinly scaled, with a hyaline patch below cell from base to vein 2; veins and a suffused terminal fascia blackish; cilia fuscous, towards tips whitish, with dark fuscous subbasal line.

Q.: Cairns (Dodd); in October, two specimens. Type in Coll. Lyell, cotype in Coll. Lower.

398. *A. thystas*, n.sp.

♂♀. 13-15 mm. Head brownish or red-brown, lower part of face in ♂ white. Palpi ascending, white, in ♀ suffused with yellow-brownish, base of all joints and a subapical band of second blackish. Thorax brownish or red-brown, variably marked or suffused with dark fuscous. Posterior tibiæ without tuft. Forewings elongate, posteriorly slightly dilated, costa slightly arched, apex rounded-obtuse, termen almost straight, vertical; red-brown, variably mixed with blackish and transversely strigulated with ochreous-whitish, sometimes almost wholly obscuring groundcolour; costa mostly blackish, with scattered oblique white strigulæ, two subconfluent pairs usually forming a pale patch before middle; two white strigulæ meeting at a right angle enclosing apex; ocellus subconical, crossed by five black dashes, and enclosed anteriorly by two obscure leaden-metallic strigæ edged with ochreous-white, and posteriorly by an irregular patch of leaden-metallic suffusion, upper portion of ocellus sometimes occupied by a suffused ochreous-whitish patch: cilia red-brownish irrorated with ochreous-white, usually spotted with blackish. Hindwings dark grey, thinly-scaled anteriorly; cilia grey-whitish, with dark grey subbasal shade.

NEW GUINEA: St. Aignan I. (Meek)—Q.: Cairns (Dodd); from September to December, seven specimens.

399. *A. phyllanthana* Meyr.

(*Antithesia phyllanthana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 641).

Q.: Brisbane (Turner) - N.S.W.: Sydney; from December to April. Larva in rolled leaves of *Phyllanthus Ferdinandi*.

400. *A. chasmodes*, n.sp.

♂. 13 mm. Head and thorax dark fuscous, face white. Palpi porrected, basal half dark fuscous, followed by a yellow bar, rest white. Posterior tibiæ internally white. Forewings suboblong, costa rather strongly arched, apex almost rectangular, termen hardly sinuate, vertical; ochreous-white; basal patch dark fuscous, outer edge straight, rather oblique; costa from before middle to near apex with some dark fuscous strigulæ, beneath which from middle is a yellow-ochreous streak; a broad dark fuscous terminal fascia, anterior edge slightly convex, running from $\frac{5}{6}$ of costa to $\frac{2}{3}$ of dorsum, including a triangular dark leaden blotch on dorsum before tornus, and two adjacent roundish brown-whitish spots extending over lower $\frac{2}{3}$ of termen: cilia whitish-ochreous, dark fuscous above apex and beneath tornus, with a dark fuscous dot below middle of termen. Hindwings rather dark grey; cilia whitish-grey, with dark grey subbasal line.

SOLOMON Is.: Choiseul (Meek); one specimen.

401. *A. scambodes*, n.sp.

♂♀. 10-11 mm. Head and thorax rather dark fuscous. Palpi porrected, dark bluish-fuscous, base white beneath, second joint with pale yellowish median spot, terminal joint yellow-whitish towards apex, in ♀ tinged with fulvous-orange. Apex of abdomen white in ♂. Posterior tibiæ without tuft. Forewings elongate, slightly dilated, costa gently arched, apex rounded-obtuse, termen rounded, rather oblique; dark bronzy-fuscous mixed with blackish and suffusedly strigulated with whitish; two pairs of white costal strigulæ before middle; four white strigulæ from costa posteriorly, beneath which is a curved orange stria almost reaching termen, margined beneath by a curved bluish-silvery-metallic stria from costa beyond middle to middle of termen, becoming orange at extremity; four subconfluent blue-leaden-metallic spots edged with pale yellowish forming posterior margin of a dark patch representing ocellus; apex in ♀ deep ferruginous, in ♂ dark fuscous, with two blue-leaden-metallic strigæ, first rising from last white costal strigula: cilia dark fuscous, mixed with bluish-leaden towards tornus, on middle of termen with two fine yellowish bars, tips paler. Hindwings with 3 and 4 stalked: dark fuscous, in ♂ thinly scaled except towards termen; cilia grey, with darker subbasal shade.

Q.: Cairns (Dodd); in October and November, three specimens.

402. *A. confertana* Walk.

(*Grapholita confertana* Walk., Cat. xxviii., 388; *G. vulgana* ib. xxxv., 1796).

♂♀. 13-18 mm. Head and thorax dark grey. Forewings rather dilated posteriorly, costa gently arched, termen faintly sinuate, vertical; dark fuscous, with irregular leaden-grey striæ edged with whitish; costa with pairs of whitish strigulæ; a blackish oblique transverse blotch from dorsum beyond middle, reaching more than half across wing, posteriorly whitish-edged; a slender ochreous-yellow subcostal streak from beyond middle to near apex, edged beneath by a blue-leaden-metallic stria; ocellus represented by an 8-shaped whitish mark edged with blackish and each half bisected by a black dash, margined anteriorly by a thick leaden-metallic whitish-edged streak, and posteriorly by three leaden-metallic whitish-edged spots. Hindwings dark grey, thinly scaled in disc and towards base, veins blackish; a terminal blackish fascia, broader towards apex.

New Guinea: Sudest I., Sariba I. (Meek)—Moluccas: Ceram. Also from Ceylon.

403. *A. endophaga*, n.sp.

♂. 14 mm. Head, palpi, and thorax dark fuscous, palpi porrected. Abdomen ochreous-yellowish, anal tuft mixed with grey. Posterior tibiæ clothed above with long pale yellow hairs. Forewings elongate-triangular, narrow anteriorly, costa almost straight, apex rounded, termen obliquely rounded; fuscous mixed with dark grey, on posterior half with some scattered ochreous-brown strigulæ; costa spotted with blackish, on posterior half with whitish irroration on interspaces; some blackish strigulæ indicating central fascia; posterior area beyond this irrorated with whitish, except on a dark leaden-fuscous streak marked with black extending from ¾ of costa to near termen in middle: cilia fuscous irrorated with white. Hindwings with dorsum clothed with long hairs; light ochreous-yellow, apex and termen narrowly fuscous; cilia whitish with grey subbasal line, on dorsum yellow.

W. AUST.: Carnarvon; one specimen bred in November. Larva cylindrical, with scattered whitish hairs; flesh-colour, darker on back; head brown, suffusedly margined with blackish; segments 2 and 3 rather broad: feeds on pods of *Acacia sp.*, eating the seeds and ejecting refuse through a hole, in October.

404. *A. gonomela* Low.

(*Arotrophora gonomela* Low., Proc. Linn. Soc. N. S. Wales, 1899, 94).

Posterior tibiæ in ♂ hairy above. Forewings narrower anteriorly than usual, costa almost straight; dark grey, irregularly sprinkled with whitish and brownish, and strigulated with blackish; a blackish transverse streak at ⅔, angulated in disc; a suffused white discal dot at ⅓: cilia with lighter and darker bars. Hindwings fuscous; dorsum in ♂ clothed with long hairs.

S. AUST.: Mount Lofty (Lower); a specimen received from Mr. Lower, and type also seen.

405. *A. tricolorana* Meyr.

(*Helictophanes tricolorana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 638).

N.S.W: Sydney; in October. Still unique.

406. *A. fungiferana* Meyr.

(*Helictophanes fungiferana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 640).

N.S.W: Parramatta; in September. This also is still unique.

407. *A. pendulata*, n.sp.

♂. 15-16 mm. Head and thorax grey, face and shoulders dark fuscous. Palpi porrected, grey, second joint with two dark fuscous spots, base white. Abdomen rather elongate. Posterior tibiæ grey-whitish. Forewings elongate, posteriorly dilated, costa gently arched, apex obtuse, termen straight, vertical; rather dark fuscous, closely and suffusedly strigulated with grey-whitish; basal area tinged with brown-reddish, with some blackish scales; a broad dark fuscous streak running in an even curve from ¼ of costa to below middle of disc and back to costa at apex, included costal space rather dark fuscous but almost covered by confluent pairs of oblique purplish-leaden strigæ rising from short whitish costal strigulæ separated with dark fuscous; a small dark fuscous spot on middle of termen; ocellus narrow, edged with pale leaden-grey whitish-margined striæ, and crossed by three dark fuscous dashes : cilia whitish-brownish, with traces of grey bars, especially in middle, above apex dark fuscous. Hindwings grey, somewhat darker towards apex; cilia whitish, rather elongated on dorsum, with grey subbasal line round apex and upper half of termen.

Q.: Brisbane (Turner); in January and April, two specimens.

408. *A. discana* Feld.

(*Tortrix discana* Feld., Reis. Nov. pl. cxxxvii., 41).

♂♀. 16-18 mm. Forewings blackish, anteriorly closely striated with leaden-metallic except on a broad band margining costal patch; a triangular ochreous-white costal patch extending on costa from before middle to ¾, strigulated with dark fuscous on costa; ocellus narrow, enclosed by two subtriangular patches of leaden-metallic striæ : cilia dark fuscous, at tornus with an ochreous-white patch. Hindwings fuscous, becoming dark fuscous posteriorly, in ♂ with a large round patch of modified black scales in disc extending almost to base; dorsal margin in ♂ somewhat expanded, white, dorsal and tornal cilia in ♂ white.

Solomon Is.: Choiseul, Bougainville (Meek)—Moluccas: Amboina (Felder); five specimens. Also from the island of Hainan, China. There are several similarly coloured species, from all of which the ♂ is obviously separated by the secondary sexual characters of hindwings; the ♀ is very like *A. amœbæa*, but may be distinguished by the less extent of costal patch, which is also much whiter.

409. *A. amœbœa* Low.

(*Dichelia amœbœa* Low., Trans. Roy. Soc. S. Austr. 1896, 161).

♂♀. 14-18 mm. Forewings with costal blotch extending from before middle to $\frac{5}{6}$; ocellus narrow, brownish, crossed by several blackish dashes, and enclosed by two broad subtriangular leaden-metallic streaks. Posterior tibiæ in ♂ clothed above with dense expansible tuft of long grey hairs.

Solomon Is.: Choiseul, Bougainville (Meek)—New Guinea: Sudest I. (Meek)—Q.: Brisbane (Lower); in December. Differs from allied similar species of the *leucaspis*-group by the tuft of posterior tibiæ in ♂.

410. *A. elæodes* Low.

(*Acanthothyspoda elæodes* Low., Trans. Roy. Soc. S. Austr. 1908, 320).

♂. 15 mm. Head and thorax dull greenish somewhat marked with dark fuscous. Palpi subascending. Abdomen blackish-grey, clothed laterally throughout with very long blackish-grey hairs. Posterior tibiæ clothed internally with dense brush of dark grey scales, basal joint of tarsi shortly rough-scaled above. Forewings elongate, posteriorly dilated, costa gently arched, apex obtuse, termen almost straight, rather oblique; dull bluish-green; costa strigulated with dark fuscous; basal patch indicated by dark fuscous strigulation, outer edge angulated in middle; an oblique series of dark fuscous strigulæ beyond this; central fascia moderate, oblique, dark fuscous; a rounded-quadrate dark fuscous blotch before termen, connected with middle of termen; three small dark fuscous spots on costa posteriorly, and one at apex; from last costal spot before apex a striga runs to termen above middle. Hindwings with dorsum dilated and clothed with dense hairs; dark fuscous, towards dorsum suffused with deep fulvous-orange; cilia pale fulvous-fuscous, with dark fuscous subbasal line.

Q.: Cairns (Dodd). Redescribed from the type; in Lower's description the characteristic hindwings are omitted, and the description of the legs is erroneous.

411. *A. phyllodes* Low.

(*Dipterina phyllodes* Low., Proc. Linn. Soc. N. S. Wales, 1899, 93).

♂♀. 15-17 mm. Forewings with termen slightly sinuate; varies a good deal in extent of black marking, in one specimen a broad median longitudinal band of blackish suffusion, edged beneath in middle with a white suffused spot.

Q.: Brisbane (Turner); from November to January. Recognisable from all other Australian species except *A. elæodes* by the green colouring. The size given by Lower (10-12 mm.) is erroneous.

412. *A. anthologa*, n.sp.

♀. 16-18 mm. Head, palpi, and thorax deep orange, palpi porrected Forewings elongate, somewhat dilated posteriorly, costa gently arched, apex rounded-obtuse, termen rounded, somewhat oblique; glossy indigo-blue-blackish; base deep orange; a rather narrow deep orange terminal fascia, widest on costa, narrowed to tornus: cilia orange, beneath tornus blue-blackish. Hindwings orange; a broad blackish terminal fascia, narrowed to tornus; cilia blackish, on dorsum orange.

Solomon Is.: Choiseul, New Georgia (Meek); three specimens.

413. *A. poetica* Meyr.

(*Argyroploce poetica* Meyr., Journ. Bomb. Nat. Hist. Soc. xix., 437; *Eucosma mosaica* ib. xviii., 139 (preocc.).

♂♀. 19-20 mm. Palpi ascending. Posterior tibiæ without tuft. Forewings brownish-ochreous; markings shining blue-grey, finely edged with whitish; a broad patch occupying costal ⅔ towards base, sending a thick curved streak from beneath costa before middle through disc, nearly reaching a round subterminal spot beneath apex, its upper edge broken by a small dark-brown spot in middle of curve; a short thick oblique streak from middle of costa, followed by some blackish suffusion; several costal dots and a subcostal dot above subapical spot; a broad dark brown streak occupying dorsal fourth towards base and continued following margin of grey marking above it to termen, where it is expanded to reach tornus; a transverse rounded spot on middle of dorsum, anteriorly edged by this streak; an irregular mark on tornus, and a subterminal dot above it. Hindwings whitish-fuscous, with broad blackish-fuscous terminal fascia.

N. AUST.: Port Darwin (Dodd). Also from India and Ceylon.

414. *A. eximiana* Walk.

(*Carpocapsa eximiana* Walk., Cat. xxxv., 1797).

♀. 18 mm. Forewings tawny-orange, with three oblique streaks from costa anteriorly, an upwards-curved longitudinal submedian streak, a curved oblique streak from middle of dorsum, an oblique streak resting on middle of termen, and three small spots on costa posteriorly dark leaden-purplish. Hindwings blackish, with rather broad orange median band.

NEW GUINEA. Roughly described from Walker's type-specimen, which is the only one I have seen.

415. *A. pyrrhopa* Low.

(*Tortrix pyrrhopa* Low., Trans. Roy. Soc. S. Austr. 1896, 161).

♀. 17 mm. Very like the following species, but groundcolour of forewing red-brown strigulated with dark fuscous, without red spots, and certainly distinct by the well-marked sinuation of termen; hindwings dark fuscous, with orange antemedian band not reaching margins.

Q.: Mackay (Lower); in December. I have seen only Lower's type, which is in poor condition.

416. *A. miltographa* Meyr.

(*Eucosma miltographa* Meyr., Journ. Bomb. Nat. Hist. Soc. xviii., 139).

♂♀. 17-20 mm. Head and thorax deep yellow-ochreous, with a broad central stripe of whitish irroration, patagia olive-tinged. Palpi yellow-ochreous tinged with crimson, terminal joint and extremity of second irrorated with whitish Forewings moderate, posteriorly dilated, costa gently arched, apex obtuse, termen straight, almost vertical; fulvous-ochreous or olive-ochreous, strewn with irregular orange-red or brown-red small spots and oblique marks, tending to form angulated transverse series, especially an angulated transverse streak beyond middle; costa with a few dark fuscous strigulæ; an irregular streak of whitish irroration with some dark fuscous scales along dorsum from near base to tornus, upper edge with an oblique acute projection beyond middle, this streak margined above with red or dark brown suffusion: cilia whitish-yellowish, basal third deep red or red-brown, with blackish spots above apex and beneath tornus. Hindwings dark fuscous, thinly scaled anteriorly, more blackish posteriorly; an orange median band, not reaching margins, interrupted in middle, lower half with blackish veins; in ♂ with dorsal fold clothed with long expansible whitish hairs; cilia orange, round apex blackish.

MOLUCCAS: Halmahera (Doherty) – NEW GUINEA: Sariba I., Woodlark I. (Meek) Q.: Cairns (Dodd); in April; five specimens. Occurs also in India and Ceylon. The form described above differs from the Indian form in the well-developed orange band and orange cilia of hindwings, but after close comparison I am compelled to regard it as only a geographical form of the same species; I think, however, it is sufficiently distinct to require a name, and therefore name it var. *miltoxantha.*

417. *A. ancalota* Meyr.

(*Enarmonia ancalota* Meyr., Journ. Bomb. Nat. Hist. Soc. xviii., 140).

♂♀. 17-18 mm. Head and thorax grey-whitish. Forewings with termen slightly sinuate, nearly vertical; yellow-ochreous mixed with ferruginous-brownish; a broad pale whitish-fuscous dorsal streak edged above with white, broadest at ¼, where it reaches more than half across wing, rapidly narrowed to tornus, upper edge with a triangular median indentation filled with brown; two posterior series of blackish dots. Hindwings in ♂ with shallow dorsal fold clothed with hairs; in ♂ pale fuscous, in ♀ rather dark fuscous.

NEW GUINEA: Woodlark I. (Meek); in April, one specimen. Occurs also in Ceylon.

65. ARTICOLLA Meyr.

Articolla Meyr., Journ. Bomb. Nat. Hist. Soc.
xvii., 976(1907) ... ... type *cyclidias.*

Antennæ in ♂ simple. Palpi moderate, porrected, second joint densely scaled, terminal joint moderate. Thorax with posterior crest. Forewings with 7 to termen, 8 and 9 stalked or closely appressed towards base. Hindwings with 3 and 4 stalked, 5 approximated, 6 and 7 stalked.

A peculiar genus, with affinities to the *Chlidanotidæ*.

418. *A. prospera* Meyr.

(*Articolla prospera* Meyr., Journ. Bomb. Nat. Hist. Soc. xix., 591).

♂♀. 14-20 mm. Palpi dark violet-bluish-fuscous, second joint with median orange spot, terminal joint fulvous or whitish except base. Forewings with costa gently arched, sinuate from $\frac{2}{3}$ to $\frac{4}{5}$, where it is rather prominent, termen straight, somewhat oblique; whitish-ochreous, sometimes partially suffused with light ochreous-brownish, in ♀ more generally, with scattered dark fuscous scales and strigulæ; a suffused dark fuscous or blackish spot on costa at $\frac{1}{4}$, and a larger triangular one beyond middle; sometimes an oblong purple-blackish blotch on dorsum before middle, its upper edge excavated, but this is sometimes nearly obsolete; a round ochreous-whitish patch in disc beyond cell, surrounded by blackish strigulæ, and connected with termen below middle by a smaller similar but less marked patch; these are margined above by a broad dark fuscous streak, followed by a white line and then by a blue-leaden-metallic stria; above this is a fulvous-orange streak, and then a bright deep ferruginous elongate patch along apical portion of costa, cut by three oblique blue-leaden-metallic strigulæ becoming white on costa. Hindwings in ♂ grey, thinly scaled, veins darker, in ♀ dark fuscous.

Q.: Cooktown (Meek), Cairns (Dodd); in September and October, four specimens. Also occurs in India.

66. PTERNIDORA, n.g.

Antennæ in ♂ simple. Palpi moderate, porrected, second joint rough-scaled above and beneath, terminal joint short. Thorax without crest. Forewings with median scale-tooth on dorsal margin; 7 separate, to termen. Hindwings with 3 and 4 closely approximated at base, 5 nearly parallel to 4, 6 and 7 closely approximated towards base.

An endemic development of *Laspeyresia*

419. *P. phlæotis*, n.sp.

♂. 9-10 mm. Head and thorax grey. Palpi dark fuscous irrorated with whitish. Posterior tibiæ without tuft. Forewings elongate-triangular, costa slightly arched, apex obtuse, termen rounded, rather oblique; grey irrorated with whitish points, with some scattered dark fuscous scales and strigulæ, on costa strigulated with dark fuscous; terminal area broadly dark fuscous, extending over ¼ of costa and nearly half of dorsum, strewn with dark iron-grey transverse marks and spots, two longer enclosing ocellus: cilia fuscous, with several rows of darker points, and a black subbasal line. Hindwings fuscous, becoming dark fuscous posteriorly; cilia light fuscous, with dark fuscous subbasal line.

Q.: Brisbane (T. Batcheler); in July, two specimens, communicated by Dr. A. J. Turner.

67. LASPEYRESIA Hb.

Laspeyresia Hb., Verz. 381(1826) ... ... type *corollana*.
Carpocapsa Tr., Schmett. Eur. vii., 231(1829) .. type *pomonella*.
Grapholitha Tr., Schmett. Eur. vii., 232(1829)... type *dorsana*.
Stigmonota Guén., Eur. Micr. Ind. 48(1845) ... type *dorsana*.
Leptarthra Low., Trans. Roy. Soc. S. Austr. 1902, 253 ... ... type *aulacodes*.

Antennæ in ♂ ciliated. Palpi moderate, more or less ascending, second joint arched, with short projecting scales beneath and sometimes above towards apex, terminal joint short. Thorax without crest. Forewings with 7 separate, to termen. Hindwings with 3 and 4 connate or stalked, 2 nearly parallel to 4, 6 and 7 approximated towards base.

A genus of considerable extent and general distribution, but not native to New Zealand. The larvæ are especially prone to feed in the pods of *Leguminosæ*, but also are found in fruits and shoots of other plants.

420. *L. pomonella* Linn.

(*Carpocapsa pomononella* Linn., Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 657).

Q.: Brisbane (Turner)—N.S.W.: Broken Hill (Lower)—Vic.: Melbourne—Tasm.: Hobart—S.A.: Adelaide; from August to March. The larva of this notorious pest feeds in apples, and occasionally in other fruits; it probably occurs in Australia whereever apple-trees are planted, but some of the above records may be of specimens bred from apples in shops, with which it is readily introduced. The species is of European origin, but occurs now wherever apples are grown throughout the world.

421, *L. metallocosma* Low.

(*Tortrix metallocosma* Low., Proc. Linn. Soc. N. S. Wales, 1901, 670).

Q.: Townsville (Dodd); in October. Larva feeds in stems of *Loranthus (Loranthaceæ)*, a large gall forming round each, which splits open at the upper end in time for the moths to emerge; many on one stem, often only an inch or two apart (Dodd).

422. *L. aulacodes* Low.

(*Leptarthra aulacodes* Low., Trans. Roy. Soc. S. Austr. 1902, 253).

Q.: Townsville (Dodd); in October. Larva feeds in stems of *Loranthus*, but without making a gall (Dodd).

423. *L. tephræa*, n.sp.

♂. 10-12 mm. Head and thorax greyish-ochreous, head sometimes whitish-tinged. Palpi whitish, tinged with greyish-ochreous towards base. Posterior tibiæ rather short, above with dense expansible tuft of long ochreous-grey-whitish hairs. Forewings elongate, posteriorly dilated, costa slightly arched, apex obtuse, termen slightly sinuate, somewhat oblique; greyish-ochreous suffusedly mixed with fuscous, irrorated with whitish points; costa strigulated with dark fuscous; three oblique blue leaden strigæ from costa posteriorly; ocellus margined laterally with leaden-metallic, and containing three black longitudinal marks: cilia fuscous sprinkled with whitish, with dark fuscous subbasal line on upper part of termen, preceded by more strongly marked whitish irroration, especially behind ocellus. Hindwings grey; cilia pale grey, with darker subbasal shade.

S-A.: Petersburg; in October, two specimens.

424. *L. ptychora* Meyr.

(*Laspeyresia ptychora* Meyr., Journ. Bomb. Nat. Hist. Soc. xviii. 147).

♂♀. 12-15 mm. Forewings with termen slightly sinuate, hardly oblique; dark fuscous, finely irrorated with ochreous-whitish except towards costa posteriorly; costa with nine pairs of whitish strigulæ, last six giving rise to short oblique leaden-metallic streaks, seventh running to termen beneath apex; ocellus margined laterally by leaden-metallic streaks, and containing three elongate black dots. Hindwings grey; in ♂ a very slender submedian hair-pencil from base, followed by a few dark grey scales, dorsal area rather broadly strewn with blackish-grey scales, dorsal edge and cilia recurved upwards to form a pocket.

Q.: Brisbane (Turner); in March and April, two specimens, Also occurs in India and Ceylon. This and the preceding species belong to a group of closely allied and superficially extremely similar species, which can, however, easily be determined in the ♂ sex by the secondary sexual characters of the hindwings and posterior tibiæ; these must be carefully noted, as it is not unlikely that others of the Indian species may be found in Australia; the larvæ of two feed in stems of *Crotalaria*, and may be introduced with it, if cultivated.

425. *L. lomacula* Low.

(*Laspeyresia lomacula* Low., Proc. Linn. Soc. N. S. Wales, 1899, 95.)

Q.: Cairns (Dodd)—N.S.W.: Broken Hill (Lower)—S.A.: Wirrabara; in October and March.

426. *L. antitheta*, n.sp.

♂♀. 11-12 mm. Head and thorax rather dark fuscous. Palpi fuscous sprinkled with whitish. Forewings elongate, posteriorly dilated, costa gently arched, apex obtuse, termen slightly rounded, rather oblique; dark bronzy-fuscous, tips of scales bronzy-yellow-whitish; costa obscurely strigulated with dark fuscous and whitish; an indistinct erect transverse blotch of whitish suffusion strigulated with dark fuscous from middle of dorsum, reaching more than half across wing, often almost obsolete; several blue-leaden-metallic strigæ from costa posteriorly, first running into a thick erect leaden-metallic streak from tornus, followed by three elongate black dots; a small leaden-metallic mark on termen above middle: cilia whitish-grey, with blackish subbasal line. Hindwings fuscous, becoming dark fuscous posteriorly; cilia pale fuscous, with dark fuscous subbasal line, tips whitish.

W.A.: Albany; from September to December, five specimens.

427. *L. parvisignana* Meyr.

(*Stigmonota parvisignana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 654.)

N.S.W.: Sydney, in August Vic.: Gisborne (Lower), from October to December.

428. *L. floricolana* Meyr.

(*Stigmonota floricolana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 656.)

N.S.W.: Parramatta, Bowenfels; in January.

429. *L. iridescens* Meyr.

(*Stigmonota iridescens* Meyr., Proc. Linn. Soc. N. S. Wales, 1381, 655.)

Q.: Warwick (Turner)—N.S.W.: Murrurundi, Bathurst, Sydney—S.A.: Adelaide; in October and November. Lord Walsingham has subsequently discribed another species of this genus from Corea and Japan under the name of *L. iridescens* (Ann. Mag. Nat. Hist. (7) vi., 429), which name, of course, cannot stand; for this Japanese species I propose the name *L. prismatica*.

430. *L. pessota*, n.sp.

♀. 9 mm. Head and thorax whitish-grey. Palpi grey-whitish. Forewings elongate-triangular, costa slightly arched, apex obtuse, termen rounded, rather oblique; grey, tips of scales whitish, towards dorsum and termen broadly suffused with dark fuscous; costa strigulated with dark fuscous; an erect hardly curved suffused whitish blotch from middle of dorsum, bisected by a dark strigula; a violet-leaden-metallic streak from beneath costa at ¾ to tornus, followed by a blackish dot near lower extremity: cilia grey, with blackish sub-basal line, tips whitish. Hindwings fuscous, paler and thinly scaled anteriorly, dark fuscous towards apex and along termen; cilia white, with dark fuscous basal line.

S.A.: Port Lincoln; in November, one specimen.

431. *L. conficitana* Walk.

(*Carpocapsa conficitana* Walk., Cat. xxviii., 412; *Stigmonota conficitana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 654.)

Q.: Brisbane (Turner); in October. A good and distinct species; both sexes seen.

432. *L. zapyrana* Meyr.

(*Stigmonota zapyrana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 653.)

Q.: Brisbane, Helidon, Toowoomba—N.S.W.: Glen Innes, Sydney, Bulli—Vic.: Melbourne, Healesville; from September to December. Larva in pods of *Hardenbergia monophylla* (*Leguminosæ*).

433. *L. callizona*, n.sp.

♀. 10-11 mm. Head and thorax dark fuscous, face yellow. Palpi yellow, towards base orange. Abdomen deep orange. Forewings elongate-triangular, costa gently arched, apex rounded-obtuse, termen straight, nearly vertical, rounded beneath; dark fuscous; a straight broad yellow fascia slightly before middle;

apical area and margins of ocellus marked with purplish-leaden strigæ, between which the ground-colour is obscurely marbled with dull fulvous, costa with four oblique blue-leaden strigulæ rising from minute white dots; two minute whitish dots on termen above middle, and one below it: celia dark purplish-fuscous, with blackish subbasal line. Hindwings deep orange; apex and upper part of termen rather broadly suffused with dark fuscous; cilia ochreous-whitish, round apex greyish-tinged, with dark fuscous subbasal line.

New Guinea: Sariba I. (Meek); two specimens.

434. *L. thœnarcha*, n.sp.

♂. 12 mm. Head and thorax dark fuscous, face yellow. Palpi yellow, base fuscous. Abdomen dark fuscous. Forewings elongate-triangular, costa gently arched, apex obtuse, termen rounded, rather oblique; dark fuscous; a broad clear yellow fascia before middle, strigulated with black on costa; costa posteriorly blackish, with four whitish strigulæ, whence rise purplish-leaden-metallic oblique strigæ; ocellus obscurely edged with purplish-leaden-metallic; two minute whitish dots on termen above middle, and one below it: cilia dark fuscous. Hindwings dark fuscous; cilia fuscous, with darker subbasal line.

Q.: Cairns (Dodd); one specimen. Differs from the preceding in the yellow fascia being nearer base, as well as in the colour of hindwings and abdomen.

435. *L. mediana* Walk.

(*Tospitis mediana* Walk., Cat. xxxv., 1798.)

Solomon Is.: Shortlands I., Isabel I., Florida, Choiseul, Gizo (Meek)—New Guinea: Sariba I., Sudest I. (Meek).

436. *L. martia*, n.sp.

♂♀. 8-10 mm. Head fulvous. Palpi porrected, ochreous, tinged with orange towards apex, second joint sometimes indistinctly spotted with dark fuscous. Thorax orange-red, anteriorly with three leaden-grey stripes, posteriorly more or less wholly leaden-grey. Abdomen dark purplish-grey, apex blackish, anal scales in ♀ flatly expanded. Forewings moderate, posteriorly dilated, costa gently arched, apex obtuse, termen slightly rounded, little oblique; deep coppery-red; anterior half of costa strigulated with black, edge ochreous between the strigulæ; three curved irregular grey transverse striæ on basal half connected by irregular bars, third median; an irregular curved blue-leaden-metallic streak from costa beyond middle to ⅘ of dorsum, posterior edge with a rounded median prominence edged with some black scales; costa posteriorly black, with four oblique blue-leaden strigulæ rising from white dots; posterior area of wing crossed by three very irregular variably connected and sometimes broken blackish striæ, and a curved series of four blue-leaden-metallic spots between second and third: cilia dark purplish-fuscous. Hindwings blackish-grey, more blackish posteriorly; cilia whitish-grey, with blackish subbasal line.

Q.: Cairns (Dodd); from October to December, three specimens. Apparently truly distinct from the following, but more material is desirable.

437. *L. aurantiana* Pryer.

(*Hemerosia aurantiana* Pryer, Cist. Ent. ii., 235, pl. iv., 12.)

♂♀. 11-13 mm. Abdomen dark grey, anal tuft in ♂ ochreous-whitish. Forewings deep orange-red, anterior ⅔ reticulated with five or six anastomosing ochreous-brownish striæ, costa minutely dotted with black; a straight blue-leaden-metallic streak from beneath ⅔ of costa to dorsum before tornus, anteriorly edged with black scales, anterior edge indented in middle; posterior area irregularly and confusedly striated with blackish, with a curved subterminal series of four blue-leaden-metallic marks. Hindwings dark grey, in ♀ blackish-grey posteriorly.

NEW GUINEA: Kei Is.—Q.: Brisbane (Turner); from February to April. Also occurs in Ceylon, India, Burma, and China.

5. CHILANOTIDÆ.

Ocelli present. Forewings with 2 from before ¾ of cell, 8 and 9 stalked or coincident. Hindwings without basal pecten on lower margin of cell, 5 parallel to 4, 6 and 7 stalked.

This curious family consists, at present, of only a few small genera of Indo-Malayan origin. It has undoubted relationship to the *Glyphipterygidæ* on the one hand, and the *Eucosmidæ* on the other, yet does not appear to be actually transitional between them, but rather to represent an offshoot from the former parallel to the latter. The palpi are often pointed or even acute as in the former, and there is more range of variation in neuration than in the *Eucosmidæ*; yet the general appearance is remarkably uniform and characteristic.

68. EPIRRHŒCA, n.g.

Antennæ in ♂ simple. Palpi moderate, ascending, second joint with rough projecting scales beneath, terminal joint short, obtuse. Forewings with 6 connected or anastomosing with 7 beyond its middle, 7 to costa, 8 and 9 out of 7. Hindwings with 3 and 4 connate or approximated at base, 6 and 7 long-stalked.

438. *E. neoris*, n.sp.

♂. 17-19 mm. Head rather dark fuscous. Palpi white, base fuscous. Thorax white, anteriorly suffused with rather dark fuscous. Posterior tibiæ clothed with whitish hairs. Forewings elongate, posteriorly rather dilated, costa slightly arched, apex strongly prominent, obtuse, termen abruptly concave beneath it; silvery-white; costa obliquely strigulated with dark fuscous except towards base, alternate interspaces fulvous; a semioval blotch of fuscous suffusion strigulated with dark fuscous extending on dorsum from ¼ to ⅜, and reaching nearly half across wing; a small dark fuscous spot towards costa at ¾, and two blackish dots near termen below middle, area round these sometimes more or less infuscated; apical portion of costa ferruginous-orange, cut by two whitish strigulæ, in apical prominence limited beneath by a snow-white longitudinal mark edged beneath with pale yellowish; lower part of termen silvery-metallic: cilia whitish, round apex marked with ferruginous-yellowish, in subapical sinuation blackish-grey towards tips. Hindwings pale silvery-greyish or light grey; cilia whitish, with light grey subbasal line.

Q.: Cairns (Dodd); from September to November, five specimens.

69. Trymaltis Meyr.

Trymalitis Meyr., Journ. Bomb. Nat. Hist. Soc. xvi., 590 (1905) .... type *margarias*

Antennæ in ♂ simple. Palpi moderate, subascending, terminal joint obtuse. Forewings with 4 absent, 7 to apex, 8 and 9 stalked, 10 closely approximated. Hindwings with 3 and 4 short-stalked, 6 and 7 long-stalked.

Besides the following, there are two Ceylon species; doubtless others will be found in the Malayan Islands.

439. *T. optima*, n.sp.

♂ ♀. 21-24 mm. Head, palpi, and thorax white. Forewings elongate-triangular, costa slightly arched, apex obtuse, termen rather obliquely rounded, slightly sinuate beneath apex; silvery-white; several slight brownish-ochreous marks on anterior half of costa; a ferruginous-orange spot on middle of costa, suffused with fuscous beneath; a patch of suffused fuscous and dark fuscous strigulation extending along dorsum from near base to near tornus; an irregular narrow fascia of fuscous suffusion with silvery iridescence running from apical spot to dorsum beyond middle, beneath middle of disc edged anteriorly with blackish-fuscous suffusion, and then by a yellow mark on angle of cell; a ferruginous-orange apical spot, containing a white longitudinal mark; five small fuscous spots with silvery iridescence along termen, uppermost and two lowest preceded by blackish dots: cilia pale grey, outer half spotted with whitish, at apex marked with ferruginous. Hindwings light greyish-fulvous, apex tinged with whitish; cilia pale fulvous, outer half spotted with whitish.

Q.: Brisbane (Turner); in November, two specimens.

440. *T. climacias*, n.sp.

♂. 17 mm. Head and thorax fuscous, apical half of patagia white. Palpi white. Forewings elongate, moderate, posteriorly rather dilated, costa anteriorly almost straight, towards apex rather abruptly arched, apex obtuse, termen obliquely rounded, slightly sinuate just beneath apex; silvery-white; costa with short oblique dark fuscous strigulæ, on posterior half with alternate interspaces tinged with fulvous; an irregular narrow grey patch suffusedly marked with deep ferruginous extending over base and along dorsum to tornus; a suffused blackish dot in disc above middle; a moderately broad irregular silvery-grey fascia near termen, indistinctly spotted with blackish suffusion; a deep ferruginous-orange spot along apical portion of costa, cut by a white strigula, and limited beneath by a white longitudinal mark edged beneath with yellowish suffusion; four slivery-grey roundish spots along termen: cilia white, with grey basal line and slightly tinged with grey towards tips, at apex marked with ferruginous. Hindwings grey; cilia white, with grey basal line, towards tornus elongated.

Q.: Cooktown (Meek); one specimen.

441. *Laspeyresia hemicosma* Low.

(*Leptarthra hemicosma* Low., Trans. Roy. Soc. S. Austr. 1908, 321.)

Having obtained further material, I find that this is really a distinct species, though very similar to *L. mediana*. It differs from that species in having the posterior tibiæ of ♂ rather short, whitish, with expansible whitish hairpencil from base above (in *L. mediana* ♂ the posterior tibiæ and basal joint of tarsi are clothed with long dense rough dark grey scales), forewings without the small dark brown spot on base of dorsum, anterior margin of brown terminal band much more convex (in *L. mediana* nearly straight), and more acutely indented beneath costa.

Q.: Cairns (Dodd); in October and November. The true *L. mediana* occurs from Borneo to the Solomon Is., but has not been found in Australia.

422. *Laspeyresia exemplaris*, n.sp.

♂ ♀. 12-14 mm. Head yellow, sidetufts of crown suffused with reddish-brown. Palpi yellow, base brownish-tinged. Thorax reddish-brown, shoulders yellow. Abdomen dark fuscous, apex ochreous-whitish. Posterior tibiæ ochreous-whitish, without tufts. Forewings moderate, posteriorly dilated, costa gently arched, apex obtuse, termen rounded, somewhat oblique; bright yellow; costa strigulated with dark fuscous; a very narrow brown basal fascia; a broad light brownish patch occupying terminal ⅔ of wing, but not quite reaching costa, partially suffused with red-brownish and irregularly strigulated with dark fuscous, anterior and posterior margins suffused with violet-metallic iridescence, anterior edged by a blackish line; an oblique blue-leaden-metallic striga traversing this patch near costa; cilia brownish, sometimes dark fuscous at apex and with two more or less marked white basal dots beneath apex. Hindwings with 6 and 7 approximated towards base; blackish-fuscous; cilia fuscous, with dark fuscous subbasal shade.

N.A.: Port Darwin (Dodd); four specimens. Extremely similar to *L. mediana* and *L. hemicosma*, but immediately distinguished from both by colour of thorax, which in those species is yellow with shoulders and anterior half of dorsum dark fuscous, as well as by absence of tibial tufts and other details.

ADDENDA.

CARPOSINIDÆ.

Meridarchis zymota Meyr.

I have lately received a ♀ obtained at Port Darwin, N. Australia (Dodd); it agrees in superficial characters with the ♂.

PHALONIADÆ.

70 (7a). Phalonia Hb.

Phalonia Hb., Verz. 393 (1826)................. type *tesserana*.

Palpi porrected. Thorax sometimes with crest. Forewings with 7 separate, to costa or apex. Hindwings with 3 and 4 separate at origin, 6 and 7 stalked.

An extensive genus, apparently absolutely restricted to Northern temperate regions, except that the following species has spread more widely.

443. *P. manniana* F.R.

♂ ♀. 11-13 mm. Head white, sides ochreous-brown. Forewings with costa moderately arched; whitish-ochreous, margins strigulated with brown; a suffusion along base of costa, an oblique streak from dorsum near base, a median fascia angulated above middle, a fascia-like spot from costa posteriorly not reaching termen, and indistinct suffusions before and above tornus deep ochreous, sometimes brown-sprinkled. Hindwings pale grey.

N.A.: Port Darwin (Dodd). Also widely distributed in India and Ceylon, to which it has spread, through Western Asia, from its home in Central and Southern Europe; it must be an insect of singularly adaptable constitution, occuring on the Wiltshire downs and at the mouth of the Ganges. The larval habits do not seem to be known, but probably the larva feeds in the heads or stems of one or more of the *Compositæ*.

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ORDINARY MONTHLY MEETING.

JUNE 28th, 1911.

Mr. W. W. Froggatt, F.L.S., President, in the Chair.

Mr. SYDNEY W. JACKSON, Chatswood; Mr. JOHN SHIRLEY, B.Sc., Brisbane; Miss FLORENCE SULMAN, Lawson; Dr. F. WATSON, 143 Macquarie Street; Mr. C. H. WILKE, Darling Point, were elected Ordinary Members.

The President called the attention of Members to a circular inviting subscriptions to the Anton Dohrn Memorial Fund, forwarded by Professor Haswell, Local Hon. Secretary and Treasurer for Australia.

The Donations and Exchanges received since the previous Monthly Meeting (31st May, 1911), amounting to 2 Vols., 62 Parts or Nos., 5 Bulletins, 3 Reports, and 6 Pamphlets, received from 39 Societies, &c., and 2 Individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. Gurney exhibited a complete series of specimens illustrating the life-history of an indigenous Braconid wasp (*Opius tryoni* Cameron), a parasite of the Queensland Fruit-fly (*Dacus tryoni*)—the first parasite of fruit-flies recorded from Australia. He showed also a specimen of the wasp bred from one of two larvæ of the introduced Mediterranean Fruit-fly (*Ceratitis capitata*) in a peach—the first and only case of this association which had come under his notice. The Queensland fruit-fly is known to attack four kinds of native fruits, and is now taking to Citrus-fruits. The wasp has only a fluctuating value in checking its natural host at present; but if it can be encouraged to give more attention to the introduced host, it may render most useful service to fruit-growers.

Mr. A. R. McCulloch exhibited, by permission of the Curator of the Australian Museum, specimens of *Leiuranus semicinctus* Lay and Bennett, and *Canthigaster bennetti* Bleeker, which he had collected at Murray Island, Torres Strait. Neither of these fishes appears to have been previously recorded from Australia, though both are well known from the East Indian Archipelago and the Pacific Ocean.

Mr. Froggatt exhibited specimens of the Kurrajong Star-Psylla, *Tyora sterculiæ* Froggatt, upon a pot-plant, showing the curious filaments produced by the larvæ on the leaves. Also specimens of parasitic Hymenoptera, in illustration of Mr. Cameron's paper.

Mr. North, by permission of the Curator of the Australian Museum, sent for exhibition, a series of skins of the Plumed Bronze-wing, or "Spinifex Pigeon," *Lophophaps plumifera* Gould, from various localities in North-western Australia, Central Australia, Northern Queensland, and South Australia. Immature birds are much paler than adults, and have a less amount of white on the breast. When fully adult, specimens from all of these States are absolutely indistinguishable from one another, in colour and measurements. As pointed out by Mr. North in the Transactions of the Royal Society of South Australia (1898, xxii., p.157), *Lophophaps leucogaster*, described by Gould from South Australia, is a synonym of *L. plumifera*. He also exhibited a skin of a Fan-tailed Cuckoo (*Cacomantis flabelliformis* Latham) presented by Mr. W. Whiting, of Lord Howe Island, the bird having been caught alive in that locality in an exhausted state, after a heavy prolonged westerly blow in May, 1911.

Mr. Cheel exhibited a very interesting series of specimens of West Australian species of *Persoonia*, from the National

Herbarium, by permission of the Director. Likewise, on behalf of Mr. Ernest I. Bickford, fresh flowering specimens of *Chamælaucium uncinatum* Schau., from a plant introduced two years ago from Geraldton, W.A., where it is commonly known as Wax-Plant.

In response to the Secretary's request, made at last meeting, for exhibits of specimens of some of the rarer Blue Mountain species of *Persoonia*, for comparison with some uncommon forms whose identification was puzzling, Mr. Baker showed *P. oblongata* A. Cunn., and *P. Cunninghamii* R.Br.; Mr. Cheel showed *P. oblongata*, *P. revoluta* Sieb., and *P. Cunninghamii*; and Mr. Fletcher showed *P. oblongata*, *P. rigida* R.Br., *P. Cunninghamii*,* a species which Mr. Cheel and Mr. A. A. Hamilton considered to be *P. media* R.Br., (recorded only from Queensland, and from the Hastings and Clarence Rivers in New South Wales, in the Flora Australiensis; whose occurrence on the Blue Mountains is, therefore, as surprising, as the fact that it should have been overlooked so long), and *P.* sp.,† obtained by Mr. H. Deane at Newnes, still to be identified.

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* *P. myrtiloides* var. *brevifolia* Benth.; see also p.348.

† *P. Cunninghamii* R.Br.

CONTRIBUTION TO OUR KNOWLEDGE OF THE CHEMISTRY OF BLOOD.

No 1. Globin Sulphate and Globin from Ox-Blood.

By E. C. Grey, B Sc., Acting Demonstrator and Assistant Lecturer in Physiology in the University of Sydney.

(From the Physiological Laboratory of the University of Sydney).

General considerations.—Oxyhæmoglobin from ox-blood has received very little attention as regards its chemical composition, and although, as is well known, this is due to the fact that the substance is not readily crystallisable, nevertheless it is not a little surprising in view of the fact that a solution of ox-blood is universally accepted as a standard solution of hæmoglobin. The fact that hæmoglobins behave differently in their properties, especially as regards their power of crystallising, is a clear indication of a difference in chemical constitution, and hence in the case of ox-blood hæmoglobin we might well expect this difference to be considerable. That such is the case is demonstrated by the results put forward in this communication. The researches of Küster* and others have almost conclusively shown that these differences are not due to any variation in the composition of the prosthetic group, and moreover since this portion of the hæmoglobin molecule constitutes only five per cent. of the whole, it cannot account for the marked differences in hæmoglobins from various sources. The difference must, therefore, certainly lie with the albuminous moiety, and this is borne out by experiment.

I have been able to show that the globin of ox-blood is more basic than that from the hæmoglobin of the horse, which has served as the material of most previous investigations This basicity is evidenced by the power of the histone to combine with nearly nine per cent. of sulphuric acid.

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* H. S. Zeit. Physiol. Chem. Bd. 40, S. 391, 1904.

EXPERIMENTAL.—*The preparation of globin from ox-blood by Lawrow's method* *

The Lawrow method is briefly as follows. An aqueous solution of hæmoglobin is poured, with constant agitation, into a large excess of a mixture of five parts of alcohol, two parts ether, and one water, the mixture having been rendered of such an acidity that 100cc. contain 0·025 grams H_2SO_4. It is necessary to add the hæmoglobin solution with care, otherwise the precipitate is likely to be contaminated with undecomposed hæmoglobin which is difficult to remove by washing. This difficulty can, however, be readily overcome by using a much larger excess of sulphuric acid than was employed by Lawrow.

In the application of Lawrow's method to the precipitation of ox-blood globin, it is necessary, on account of the greater basicity of the globin, to employ more sulphuric acid, as will be seen from the following experiment.

EXPERIMENT 1.

Alcohol	1000cc.
Ether	400cc.
Water	120cc.
H_2SO_4 N/10	80cc.

To this mixture were added 50cc. of blood-solution containing the hæmoglobin from exactly 25cc. of defibrinated ox-blood. The solution was thoroughly shaken during the addition of the hæmoglobin in a stoppered bottle, and the flocculent white precipitate allowed to settle. Of the hæmoglobin solution, 50cc. more were now cautiously added, with constant shaking; the precipitate which formed was of deep red colour, and moreover the solution did not darken as before, indicating that the further quantity of hæmoglobin had not been decomposed. A portion of the supernatant fluid was tested, and found almost neutral to methyl orange, and neutral to dimethylamidoazobenzol, but acid to phenolphthalein. Moreover, on addition of a large excess of sulphuric acid, the precipitated hæmoglobin was immediately split, the hæmatin dissolving and darkening the solution, and the red colour of the precipitate giving place to the white of the globin. There is another interest attached to this experiment. As was pointed out, the supernatant fluid was acid towards phenolphthalein, although neutral to methyl orange.

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* H. S. Zeit. Physiol. Chem. Bd. 26, S. 343, 1898.

Of the supernatant fluid, 250cc. required 1·0cc. N/10 Na_2CO_3 to render the solution distinctly alkaline to methyl orange. Of the same solution, 250cc required 3·3cc. N/10 NaOH to produce the first pink colour with phenolphthalein. It is clear, therefore, that organic acids are produced in the solution during the decomposition of hæmoglobin with sulphuric acid. This fact has been pointed out before by other observers.

Hæmatin was completely removed from the solution before titration, by boiling till precipitated and filtering.

Since the total volume of the fluid used in this experiment was 1650cc., and this volume contained 80cc. N/10, H_2SO_4, every 100cc. contain 0·024 gram of sulphuric acid, which is practically the quantity recommended by Lawrow. This experiment shows, therefore, that more sulphuric acid is necessary to precipitate globin from ox-blood than from the hæmoglobin of the horse.

It should be mentioned that these experiments, in which an exact quantity of sulphuric acid was used, were carried out after I had previously ascertained, by analysis of the precipitated globin, that the substance contained a considerable amount of chemically combined sulphuric acid, a conclusion which was arrived at independent of Lawrow's work. At that time, the globin was precipitated in the presence of a larger amount of sulphuric acid, 2cc. per litre, for 50cc. of 50% solution of ox-blood.

EXPERIMENT 2.—*On the weight of globin obtainable from ox-blood.*

Method.—The Lawrow method was modified by the use of a larger excess of sulphuric acid. The details of the operation were also different, and are described below.

Defibrinated ox-blood was used in all the experiments, the oxygen capacity of the blood being previously determined. In order to avoid any loss, the operation of centrifuging the corpuscles and washing away the serum was carried out on a number of small lots of blood which were subsequently united. Twelve lots of defibrinated blood, 50cc., were carefully measured, and washed in the centrifuge with normal saline 0·9% NaCl, until the washings gave no precipitate with potassium ferrocyanide and acetic acid, or with nitric acid. The corpuscles were then dissolved in distilled water, the contents of each tube being made up to 100, and the solutions filtered. Of these filtrates, 50cc., therefore, represent the hæmoglobin from 25cc. of defibrinated ox-blood. Four lots of 100cc. of the filtrate were taken and precipitated as below. These experiments were carried out during the progress of other work, and, owing to the fact that about two months were taken up in the drying of the globin precipitates, a somewhat unique preparation was obtained. The details are as follows. Of the hæmoglobin solution, 100cc. were poured gradually into 1600cc. of a mixture of alcohol, ether, and water in the proportions 5: 2: 1, the solution having been previously acidified with 2cc. of sulphuric acid. The flocculent precipitate was allowed to settle. The dark-coloured solution was then removed by suction through cloth stretched over the broad end of a thistle funnel. This method is rapid, and permits of the precipitate being repeatedly washed without incurring any loss, as would happen using filter paper. The washing was continued until the fluid was no longer coloured. The precipitates were then transferred to weighed centrifuge-tubes, and the washing finished in the centrifuge with absolute alcohol, and finally with ether. The precipitates when centrifuged, occupied about 70cc. in volume. The tubes were now placed in the incubator at 37°C., where they remained for six weeks. In order to assist in the drying, vessels containing quick lime were also placed in the warm chamber. At the end of this time, the tubes were transferred to an oven at 50°C., and remained there for two more weeks. The tubes were now of constant weight. The material occupied about 20cc., and was of the consistency of partially baked porcelain. The preparation certainly appeared different from the material previously prepared in the laboratory, and the conclusion seemed justifiable that we were dealing with pure anhydrous globin, or, as it was subsequently shown to be, globin sulphate. It is a difficult matter to remove all the water from the globin prepared in the ordinary way and dried quickly at

100°C., and it is probable that, even when heated to 100°C. for many days, the preparation still contains water in some form of combination. It is interesting to note, therefore, the nature of the precipitate prepared by very gradual dessication lasting about two months, and at a temperature never exceeding 50°C.

The weights obtained were as follows :

Globin sulphate from 50cc. defibrinated ox-blood.

(a) 8·94 grams.
(b) 8·84 ,,
(c) 8·38 ,,
(d) 8·34 ,,
(e) 8·48 ,,

It was found, unfortunately, that Nos. (a) and (b) contained particles of glass, and they were, therefore, not included in calculating the mean value. The last estimation, No. (e), was carried out in two days by drying the globin in an open glass vessel at 110°C.

The percentage of globin sulphate yielded by ox-blood is, therefore,

	Globin sulphate weighed from 100cc. ox-blood.		Calculated to original globin.
No.1	16·76		15·40
No.2	16·68		15·32
No.3	16·94		15·58
Mean	16·79	Mean	15·43

The figures in the second column are found by deducting the amount of combined sulphuric acid, viz. 1·36 grams determined in the manner to be described later, from the figures of the first column.

There is a good indication, therefore, that the Lawrow method of obtaining globin sulphate gives a product of constant composition.

This is further borne out by the determination of the nitrogen and sulphur in many specimens of the sulphate obtained under various conditions, as regards the concentration of sulphuric acid in the precipitating fluid.

EXPERIMENT 3. – *The sulphur in globin and globin sulphate from ox-blood.*

The total sulphur in the globin sulphate was determined by moistening with a strong solution of KOH, evaporating to dryness, and subsequently fusing with an additional quantity of Na_2CO_3 and KNO_3; the sulphates were precipitated in hot solution by addition of $BaCl_2$.

The precipitates were collected on filter paper, and, after washing and drying, were ignited, and the ash reheated with a few drops of concentrated sulphuric acid.

a)	0·7111 gram	globin	sulphate	gave	0·1610	gram	BaSO	S 3·11%
(b)	0·7239 gram	,,	,,	,,	0·1747	,,	,,	S 3·29%
*(c)	0·2285 gram	,,	,,	,,	0·0496	,,	,,	S 2·98%
(d)	0·5500 gram	,,	,,	,,	0·1134	,,	,,	S 3·01%
					Mean value for sulphur			S 3·05%

It was next of importance to determine how much of this sulphur was present in the globin sulphate as sulphate, and how much as sulphur itself.

An attempt was made to determine this by difference, but the result was not satisfactory, the percentage of organically combined sulphur being found to be too high.

The percentage of sulphur was, therefore, determined in a sample of globin prepared by precipitation in the absence of sulphuric acid, The result gave 0·45 as the mean percentage of sulphur in globin. From this figure, and the data given above for the total sulphur, in globin sulphate, it is possible to calculate the proximate composition of globin sulphate.

EXPERIMENT 4.—*The direct determination of the organically combined sulphur in globin of ox-blood.*

Preparation of the globin :

Alcohol	500cc.
Ether	200cc.
Water	100cc.
Trichloracetic acid	10grams.
Ox-blood 50% solution	50cc.

The blood-solution was poured into the acid alcohol-ether mixture, and the solution set aside for some days. No precipitate appeared; water was now gradually added, and the precipitate, which thus separated, was filtered and washed with alcohol-ether mixture.

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* I am indebted to Dr. J. M. Petrie, F.I.C., for this sample (c) of globin, which was prepared by him last year. I would express my thanks to him also for many suggestions relating to the Lawrow method.

25 cc. ox-blood gave 3·96 grams protein—15·84 per cent.

Data of Sulphur Determination.

(1) 0·2700 gram protein gave 0·0094 gram $BaSo_4$ $S = 0·47\%$

(2) 0·6460 gram protein gave 0·0200 gram $BaSO_4$ $S = 0·43\%$

Mean $S = 0·45\%$

From this value for organically combined sulphur in globin, it is possible, as shewn below, to calculate the distribution of the sulphur in globin sulphate, and also the proportions in which the globin and the sulphuric acid stand related.

In globin sulphate.

Organically combined sulphur..................	0·41%
Sulphur as sulphuric acid........................	2·64%
Total sulphur	3·05%

Calculation of the composition of globin sulphate.

Assuming 100 parts globin sulphate to contain x parts globin, since, by experiment, globin contains 0·45 per cent. S.

Then the amount of organically combined sulphur in 100 parts of globin sulphate is equal to $0·0045x$.

Again 100 parts of the sulphate contain $(100\text{-}x)$ of H_2SO_4.

Therefore, sulphur present as H_2SO_4, is equal to $(100\text{-}x)\frac{16}{49}$ per cent.

But $(100\text{-}x)\frac{16}{49} + 0·0045x =$ total sulphur in globin sulphate; and, by experiment, the total sulphur was found to be 3·05%.

$$\text{Hence } (100\text{-}x)\tfrac{16}{49} + 0·0045x = 3·05$$

$$100\text{-}x + 0·0137x = 3·05$$

$$0·9863x = 90·667$$

$$x = 91·92$$

Hence for globin sulphate:

Globin..................	91·92 per cent.
Sulphuric acid..........	8·08 ,,

The determination of the nitrogen in the sulphate of globin from ox-blood, and the calculation of the nitrogen in the original globin.

The nitrogen was determined by Kjeldahl :

(1) 0·2635 gram of sulphate of globin required			27·6cc.	N/10 H_2SO_4	N 14·62%
(2) 0·1902 gram	,,	,,	20·3cc.	,, ,,	N 14·94%
(3) 0·3897 gram	,,	,,	41·2cc.	,, ,,	N 14·80%
(4) 0·5863 gram	,,	,,	62·1cc.	,, ,,	N 15·00%
			Mean of three determinations		N 14·91%

16·79 grams of globin sulphate are equivalent to 15·66 grams of globin.

Hence the percentage of nitrogen in globin....... N 15·98%

Calculated to ash-free globin........................ N 16·03%

The percentage of nitrogen in globin from horse-hæmoglobin, according to Shulz*................. N 16·89%

Determination of the ash.

0·2437 gram of globin sulphate gave 0·0008 gram ash, 0·32%.

The ash found by Shulz in globin from horse-blood was 0·58% 0·84 %.

GENERAL CONCLUSIONS.

(1) Each hundred cc. of ox-blood yield 16·79 grams of globin sulphate, which is equivalent to 15·43 grams of globin.

(2) The globin from ox-blood is more basic than that from the hæmoglobin of the horse.

(3) The sulphate of globin precipitated from solutions containing varying concentrations of sulphuric acid is of constant composition, containing 8·08% sulphuric acid.

(4) The percentage of nitrogen found in the globin sulphate is 14·9, from which the calculated percentage of nitrogen in the globin from the blood of the ox is 16·03%.

(5) The globin precipitated by trichloracetic acid was found to contain 0·45 per cent. sulphur.

In conclusion, I beg to express my thanks to Professor Anderson Stuart, in whose laboratory this work has been done.

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* H. S. Zeit. Physiol. Chem. Bd. 24, S. 449, 1898.

ON THE AFFINITIES OF CÆNOLESTES.

[MARSUPIALIA].

BY R. BROOM, M.D., C.M.Z.S., Corresponding Member.

In 1895, Oldfield Thomas described the remarkable South American marsupial, *Cænolestes*; and gave reasons for believing that it represented a new type of Diprotodontia, and apparently a living representative of a group previously known by a few extinct forms.

With regard to its affinities, Thomas considered that it is closely allied to none of the living forms, but that it is more nearly related to the existing marsupials of Australia, than to those of America. "It is," he adds, "clearly a Diprotodont, as not only does it possess the characteristic development of the lower incisors, but even the molars resemble most closely in structure those of certain members of the family *Phalangeridæ*, while being wholly unlike those of the typical Polyprotodonts. From all of the existing Diprotodonts, however, apart from its habitat and numerous detailed differences, *Cænolestes* is at once distinguished by its not being syndactylous, a character which is always considered as of family rank. It forms, therefore, among existing Marsupials a peculiar Family, and one which in America represents the Diprotodonts of Australia, just as the *Didelphyidæ* do the Polyprotodonts."

In 1896, I had an opportunity, through the kindness of Mr. Thomas, of examining the type-skull; and I then came to the conclusion that *Cænolestes* was much more nearly allied to the American Polyprotodonts than to the Australian Diprotodonts. When dealing with the affinities and habits of *Thylacoleo*, in a paper published in 1898, I gave a diagram of what I regarded as the phylogenetic relationships of the

Diprotodonts; and, in connection therewith, I stated "*Cænolestes* has been omitted, as I consider the evidence which would place it with the Australian Diprotodonts not sufficiently strong, and in any case it is evidently not a near ally of any of the Australian forms."

Most recent authors seem to have accepted *Cænolestes* as a primitive, but true Diprotodont. In October, 1909, however, a paper was published by Miss Pauline H. Dederer, in which she compares *Cænolestes* with known Polyprotodonts and Diprotodonts.* She shows that *Cænolestes* exhibits many Polyprotodont characters, and only very few Diprotodont; and her conclusions may be given in her own words. "Sinclair concluded that Cænolestes is very like the primitive Phalangers, and the two families are probably related, not convergent; that, while the fossil Cænolestidæ are too specialised in tooth-structure to be the direct ancestors of the Phalangers, yet there is probably a common ancestry. Later, he gave weight to the possibility of convergence to account for the resemblance in tooth-structure. This latter view would seem to be more in accord with the facts known about Cænolestes, for excepting tooth-structure, there appears to be no other important character which links it with the Diprotodonts, and there are several, as given above, which link it with the Polyprotodonts. While there is undeniably a series of forms connecting Cænolestes with the Diprotodonts in tooth-structure, yet Cænolestes itself is so generalised in this respect, that we may perhaps, in the absence of other corroborating characters, question its inclusion within this group. Possibly it may be found to be an offshoot from the Polyprotodonts, as it appears structurally to be more generalised than any Diprotodont, and, therefore, it might well occupy a separate suborder, as Thomas suggested—the Paucituberculata of Ameghino." Thomas had suggested that a further knowledge of the soft parts, skeleton, and milk-teeth might necessitate the separation of *Cænolestes* from the Diprotodonts, and the placing of it and its fossil allies in a distinct suborder.

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* American Naturalist, xliii., 614.

Gregory, in his most important work on the orders of mammals, accepts Miss Dederer's conclusion, and places *Cænolestes* in a separate suborder—the Paucituberculata—equivalent to the suborders Polyprotodontia and Diprotodontia. In the diagram he gives of the phylogeny of the marsupials, he derives the Cænolestoids quite independently of the Phalangeroids from a generalised Polyprotodont which lived in Upper Jurassic times.

It is admitted by all that *Cænolestes* resembles the Diprotodont in only two points, which, as stated by Miss Dederer, are—"(1) Condition of teeth: (a) one large lower incisor, cutting, projecting forward; (b) other incisors and canine in lower jaw vestigial as in Epanorthidæ; (c) anterior premolars small, showing tendency towards condition seen in Phalangers, where they are vestigial. (2) Pattern of teeth—molars like Phalanger molars rather than the Polyprotodont type."

On the other hand, Miss Dederer gives a list of ten Polyprotodont characters shown by *Cænolestes*, though one of those given, the equality of the fore and hind limbs, is of little importance, and had better be omitted. The remaining Polyprotodont characters are:—

"(1) Dental formula like that of the Dasyurid genera *Thylacinus*, *Phascologale*, namely: i. $\frac{4}{3}$ c. $\frac{1}{1}$ pm. $\frac{3}{3}$ m. $\frac{4}{4}$; in this family, the incisors are numerous, small, subequal; canines larger than incisors. This agrees with the condition in the upper jaw of *Cænolestes*."

"(2) Close resemblance in external form to *Phascologale*—rat-like or opossum-like in form (Thomas)."

"(3) Resemblance to Dasyurus skull, (*a*) in general shape, (*b*) pterygoid processes of palatine slender and delicate, (*c*) alisphenoid bullæ similar in general form."

"(4) Marked resemblance to Antechinomys and Sminthopsis skulls in size, shape, and delicate character of the bones; absence of strong crests or ridges."

"(5) Palate long and narrow, similar to characteristic Polyprotodont form, with long and narrow palatal vacuities."

"(6) Lower jaw very similar to Dasyurus, Phascologale, and especially to Antechinomys and Sminthopsis in inflection of angle, and proportionate size of angle, condyle, and coronoid."

"(7) Rudimentary pouch (Thomas, after Tomes), as in Phascologale and Marmosa."

"(9) Pes non-syndactyl, as in Dasyures and opossums."

"(10) Foot plantigrade—resembles Phascologale in number and position of pads, and short clawless hallux (Thomas)."

While one or two of these characters may not, in themselves, have very much weight in determining affinities, most of them are of great importance; and the assemblage of these numerous Polyprotodont characters in one animal makes the case so strong in favour of a Polyprotodont affinity, that only the presence, on the other hand, of very strong Diprotodont characteristics would suffice to outweigh them.

The more one goes into detail, however, the more striking does the Polyprotodont affinity become; and, in addition, to the characters noted by Miss Dederer, the following others may be mentioned.

Unfortunately the soft parts are not known, but there is reason to believe, from the structure of the bones, that the arrangement of the nasal cartileges is much more typically Polyprotodont than Diprotodont. The turbinal springs, as in Polyprotodonts from low down on the nasal wall. The nasal floor is also, as in Polyprotodonts, a wider groove than in Diprotodonts. Further, the arrangement of the palatine processes of the premaxillæ is also typically Polyprotodont.

The structure of the tympanic region is, in every detail, typically Polyprotodont, and quite unlike the condition in any Diprotodonts. The tympanic bone is a slender ring, which is protected by a well developed, thin alisphenoid bulla. An exactly similar condition is found in the Didelphids, and a somewhat similar condition in the Dasyurids and Peramelids. The arrangement of the foramina in the squamosal bone, and the relations of the squamosal to the periotic are all typical Polyprotodont characters.

In the relationships of the bones, and the foramina in the posterior basicranial region, *Cænolestes* closely resembles the primitive Didelphids, such as *Marmosa*, and less closely the Australian Polyprotodonts; while the differences from the conditions in the Diprotodonts are considerable.

Apart from the condition of the teeth, *Cænolestes* is a typical Polyprotodont in all its cranial characters, and the question to be considered is whether the Diprotodont-like character of the teeth is of sufficient weight to place *Cænolestes* among the Diprotodonts, in spite of the cranial characters all pointing in the other direction.

Now while a type of dentition may remain practically unaltered throughout long ages, if the habit remains the same, it is surprising how readily the type may be altered with change of habit. Thus in the Didelphids we find a dentition which has remained with little change throughout the Tertiary period. But the Diprotodonts of Australia, though closely related, have, in probably a very much shorter time, evolved in a number of very different ways. Further, numerous instances can be given of animals in no way nearly related to each other, evolving closely similar types of dentition. For example, take the molars of *Notoryctes* and *Chrysochloris*, or of *Diprotodon* and *Dinotherium*. And a Diprotodont arrangement has been independently evolved in in a large number of the mammalian orders, *e.g.*, Multituberculata, Rodentia, Ungulata, Primates, Chiroptera, and even to some extent in the Insectivora.

Though in *Cænolestes* the dentition bears a superficial resemblance to that of the Diprotodonts, it really differs in some important points. In the first place, no known Diprotodont has more than three incisors; *Cænolestes* has four. In Diprotodonts, the canine, though often present, is always of less importance than the incisors; in *Cænolestes*, the upper canine is larger than the incisors. The molars undoubtedly are more like those of the Diprotodonts than the Polyprotodonts; but when we look at the molars of some of the bandicoots, we see that *Cænolestes* is not so very far removed from known Polyprotodont types; and the last two molars seem still to retain a considerable amount of Polyprotodont character. The lower first incisors are undoubtedly developed to a degree quite unknown in any Polyprotodont, but we find a tendency to the increase of the first incisors in a number of Polyprotodonts. In *Phascologale*, it is so well marked, that this genus might be looked upon as incipiently Diprotodont, the first incisor both above and below being much longer than the other incisors, and nearly as large as the canines.

Miss Dederer, Dr. Gregory, and Sinclair, while agreeing that *Cænolestes* should not be placed in the Diprotodontia, prefer to place it in a distinct suborder, the *Paucituberculata*. But it has long seemed to me that, as *Cænolestes* differs from the typical Polyprotodonts only in tooth-specialisation, it should not be removed from the Polyprotodontia, but merely be made the type of a distinct family, or section at most. If the acquirement of a diprotodont dentition is to lead to an animal's being placed in a distinct suborder, then *Chiromys* must be removed from the Prosimiæ, and *Desmodus* from the Microchiroptera.

NOTES ON SOME MALLOPHAGAN GENERIC NAMES.

By T. Harvey Johnston, M.A., D.Sc., and Launcelot Harrison.

A certain amount of confusion has crept into the generic nomenclature of the Insects belonging to the order Mallophaga. Many of the errors have been corrected by Neumann(1906), but there are, however, a few important points in which we differ from the well known French parasitologist. In order that the matters referred to by us might be more easily understood, a very brief sketch of the previous work on certain generic names in this group is necessary.

The difference between "biting lice" and "sucking lice" was first recognised by De Geer(1778), who founded the genus *Ricinus* to include the mandibulate forms, the old name *Pediculus* being retained for the true lice, whose affinities are rather with the Hemiptera than with any other order. Hermann(1804), knowing *Ricinus* to be preoccupied in Botany, proposed *Nirmus* as a substitute. Nitzsch, in 1818, published a very important work on parasitic Insecta, including the Mallophaga, but took no notice of previous attempts at classification, beyond placing the earlier generic names as synonyms of his own. He divided the order into two families, to which, however, he did not assign names, these being first given, in 1832, by Burmeister. Each family consisted of two genera, one parasitic on mammals and one on birds. The bird-infesting genera were subdivided by Nitzsch into a number of subgenera as follows:—

Fam. Philopteridæ: (1) *Trichodectes*; (2) *Philopterus* (subgenera: *Docophorus*, *Nirmus*, *Lipeurus*, *Goniodes*).

Fam. Liotheidæ: (1) *Gyropus*; (2) *Liotheum* (subgen.: *Colpocephalum*, *Menopon*, *Trinoton*, *Eureum*, *Læmobothrion*, *Physostomum*).

In the case of the two subdivided genera, all species were left in the original genus in each case, but were grouped under the headings of the various subgenera. These subgenera, though ostensibly retaining that rank, were practically treated as genera by Burmeister(1832), Denny(1842), Giebel(1874), Piaget(1880, 1885), and Taschenberg(1882). It was Kellogg(1896, p.60), who first openly raised the subgenera to genera.

Neumann(1896, pp.56, 60) has pointed out that Hermann had no real justification for erecting *Nirmus*, hence his genus must be ranked as a synonym of *Ricinus*. Moreover, *Nirmus* Nitzsch (1818) could not stand, as the name had already been used by Hermann. Neumann accordingly substituted *Degeeriella* for Nitzsch's genus. He went on to point out that, in the elevation of the subgenera to genera, the original genera had not been retained, and he, therefore, took the first described species under the first named subgenus in each case as the type of the original genus. Thus *Docophorus* was replaced by *Philopterus* (with *P. ocellatus* Scop., as the type), and *Colpocephalum* by *Liotheum* (with *L. zebra* N., as the type). Finally, he considered the question of reinstating *Ricinus*. He has credited Piaget with pointing out that the first species described by De Geer, under his genus as *Ricinus fringillæ*, was subsequently included in *Physostomum* N., whereas that author, as well as Giebel and Denny, have, in this matter, simply followed the synonymy given in Nitzsch's work. *Ricinus fringillæ* De Geer, was made the type-species of the genus by Neumann, and was said to be probably identical with *Physostomum irascens* N. Nitzsch, Denny, and Giebel have, however, definitely placed *R. fringillæ* as a synonym of *Ph. nitidissimum* N., admitting the identity of the two forms. No reasons are advanced by Neumann to show that the latter admission is incorrect. We may therefore conclude that Nitzsch's *Ph. nitidissimum*, rather than his *Ph. irascens*, is the same species as that named by De Geer as *R. fringillæ*, and designated as type of *Ricinus* by Neumann. This author is correct in regarding *Physostomum* as a synonym of the latter genus; but it appears to us that the fate of the genera *Liotheum* and *Colpocephalum* is also dependent on the above facts.

Our view of the matter will be seen from the following statement. De Geer founded the genus *Ricinus*, but, as no type had been designated and all the species had been allotted to later genera, Neumann was at liberty to designate a type from amongst De Geer's original species. *R. fringillæ* having been selected, *Physostomum* N., becomes a synonym of *Ricinus* on account of the former including the type-species of the latter amongst its original species. Nitzsch, however, regarded *Physostomum* as a subgenus, and consistently referred to every species under its generic and not under its subgeneric name. Thus *Ricinus fringillæ* De G., appeared in Nitzsch(1818) as *Liotheum nitidissimum*. Hence *Liotheum* N., includes the designated type of the earlier genus *Ricinus*, and must be ranked as a synonym of the latter. We do not think that it is permissible to fix a type for *Liotheum* as well as for *Ricinus*, seeing that the type of the latter is already included in the former. We have consulted papers by Stiles(1905), and Blanchard(1906), but have not noticed any direct ruling on the point involved. Stiles(1905, p.26), in writing of subdivided genera, states that "if a type is designated, the original generic name always follows the subdivision containing the type." Thus *R. fringillæ* must pass into *Liotheum* before it can reach *Physostomum*. The last-mentioned must be the type-subgenus (in the Nitzschian sense) of *Liotheum*, *i.e.*, of *Ricinus* since it includes the type of the genus. *Colpocephalum* N., would thus maintain its individuality.

Apart from the question of nomenclatural propriety, there can be no doubt as to the expediency of our view, for we would retain the well known genus *Colpocephalum*, which included 137 species up to 1908(Kellogg, 1908), whereas Neumann would reduce it to a synonym of *Liotheum*, a generic name which has remained practically unused since Nitzsch's day. We would place both *Liotheum* N., and *Physostomum* N., as synonyms of *Ricinus*, thus involving a change in the generic names of the twenty-nine species hitherto included under *Physostomum* (*vide* Kellogg, 1908), a change that is inevitable, as has already been pointed out by Neumann. *Liotheum* Neum., *nec* Nitzsch, accordingly becomes a synonym of *Colpocephalum*.

Among certain philopterid genera, an extraordinary confusion has arisen, the various stages of which are as follows. In 1835, Dufour described a parasite, *Philopterus brevis*, from an albatross, this species being made the type of the genus *Docophoroides* Denny(MSS.) by Giglioli in 1864, a valid generic diagnosis being given. Nitzsch had named the same insect *Lipeurus taurus*, but since his description was not published until 1866 (p.385), it cannot claim precedence. Subsequent writers apparently recognise these facts in their synonymy, but Denny's genus has not received due recognition. In 1866, Rudow founded *Trabeculus* for a closely allied parasite, *Tr. schillingi*, from a petrel; and, four years later, ignoring his own prior action, created a new genus, *Oncophorus* (nec *Oncophora* Dies., a nematode genus) with the same type. In 1882, Taschenberg erected *Eurymetopus* with *Lipeurus taurus* N., as type, recognised Rudow's *Oncophorus schillingi* as congeneric, after having examined the type-specimen of the latter, and placed this species under his own genus. Piaget, in 1880, added several species to *Oncophorus* Rudow, dividing them into two groups, the Docophoroides and the Nirmoides; but he was obviously not too sure of his ground, since, though he included Rudow's species in his descriptions, he did not include it in his key to the genus. Taschenberg having removed *O. schillingi* from the genus *Oncophorus* into his *Eurymetopus*, Piaget in 1885 (p.35) claimed the genus as "*Oncophorus*, m." Kellogg(1896, p.68) has indicated some of these facts, but has not offered any comment, while Neumann appears to have overlooked them, and to have accepted Piaget's genus as being identical with Rudow's *Trabeculus*, which name he allowed to stand. He gave a new name, *Taschenbergius*, in place of *Eurymetopus*, a name already preoccupied as a genus of Coleoptera by Schönherr in 1840. From the foregoing it is obvious that *Docophoroides* Denny, stands, with *Trabeculus* Rud., *Oncophorus* Rud., *Eurymetopus* Tasch., and *Taschenbergius* Neum., as synonyms, for the forms from petrels; while a new generic name is required for the species from *Rallidæ*, etc., grouped by Piaget and later writers under *Oncophorus* (*O. schillingi* and allied Docophoroid forms being excluded). For this group of species, we propose the name *Rallicola*, which differs etymologically from *Rallicula* Schleg., 1871, in ornithology. *O. attenuatus* N., has been selected by us as the type-species.

Neumann has already replaced *Nitzschia* Denny, 1842 (*nec* v. Baer, 1827) by *Dennyus*, and *Piagetia* Picaglia, 1885, (*nec* Ritsenia, 1874) by *Piagetiella*. Picaglia's paper is not available to us, and his genus has not been taken into account by Kellogg, beyond the mere mention of it in his bibliography(1896, p.36). The species are listed under *Menopon* in the latter's list (Kellogg, 1908). We are, therefore, not able to give any opinion as to the value of the genus. A subdivision of the unwieldy *Menopon* is, however, desirable. *Eureum* N., is included by Neumann in his list of genera, though Kellogg(1899, p.133) has shown it to be based on immature forms of a Menopon. The latter author has studied *E. malleus* N.,(= *M. malleus*), which, being the better known of Nitzsch's two species, may be taken as the type.

In a later publication, Neumann (1909, p.9, footnote) has changed *Ornithobius* Denny, to *Ornithonomus*, as he considers the former name to be preoccupied by *Ornithobia* Meigen, 1832, in Diptera. In the recommendations under Art.36 of the International Code, as given by Stiles(1905, p.47), and by Blanchard (1906, p.32), this is not allowed to be sufficient grounds for the rejection of a name. We have accordingly placed *Ornithonomus* Neum., as a synonym of *Ornithobius* Denny, in the list of genera appended. Piaget(1880, p.378) has already shown that *Metapeuron* Rudow, (type *M. punctatum* Rud., = *O. cygni* L.) is a synonym of this genus.

The following genera, proposed prior to Neumann's paper, have been omitted by him, viz., *Nesiotinus* Kellogg, 1903; *Philoceanus* Kell., 1903; *Ornicholax* Carriker, 1903; *Kelloggia* Carriker, 1903; *Heterodoxus* Le Souëf & Bullen, 1902; *Latumcephalum* Le Souëf, 1902.

In conclusion, we append a list of the twenty-eight genera at present existing, indicating the types where our available literature has permitted. Such of these types as are marked with an asterisk(*), have been designated as such by ourselves, and, for the most part, have been selected from the available species on account of their occurrence on common domestic animals, or on other hosts which are fairly readily obtainable.

A. Suborder ISCHNOCERA Kellogg.

Fam. *Trichodectidæ*:—

1. *Trichodectes* N., 1818.—**T. canis* Degeer (syn. *T. latus* N.).

Fam. *Philopteridæ*:—

2. *Philopterus* N., 1818 (syn. *Docophorus* N., 1818)—*P. ocellatus* Scop.
3. *Nesiotinus* Kell., 1903.—*N. demersus* Kellogg.
4. *Kelloggia* Carriker, 1903.—*K. brevipes* Carr.
5. *Ornicholax* Carriker, 1903.—*O. robustus* Carr.
6. *Akidoproctus* Piaget, 1878.—*A. marginatus* P.
7. *Giebelia* Kellogg, 1896.—*G. mirabilis* K.
8. *Degeeriella* Neum., 1906 (syn. *Nirmus* N., 1818, nec Herm., 1804).—**D. discocephalus* N.
9. *Docophoroides* Denny in Giglioli, 1864 (syns. *Trabeculus* Rud., 1866; *Oncophorus* Rud., 1870, nec Piaget, 1885; *Eurymetopus* Tasch., 1882, *Taschenbergius* Neum., 1906).—*D. brevis* Dufour.
10. *Goniodes* N., 1818.—**G. pavonis* L. (syn. *G. falcicornis* N.).
11. *Goniocotes* Burm., 1835.—**G. gallinæ* Deg. (syn. *G. hologaster* N.).
12. *Ornithobius* Denny, 1842 (syn. *Metopeuron* Rud., 1870; *Ornithonomus* Neum., 1909).—*O. cygni* Linn.
13. *Bothriometopus* Tasch., 1882.—*B. macrocnemis* N.
14. *Philoceanus* Kellogg, 1903.—*P. becki* K.
15. *Lipeurus* N., 1818.—**L. caponis* Linn. (syn. *L. variabilis* N.).
16. *Rallicola* nobis, 1911 (syn. *Oncophorus*, Piag., 1885; nec Rudow, 1870).—**R. attenuatus* N.

B. Suborder AMBLYCERA Kellogg.

Fam. *Gyropidæ*.

17. *Gyropus* N., 1818.—**G. ovalis* N.

Fam. *Ricinidæ*.†

18. *Ricinus* Degeer, 1778 (syns., *Nirmus*, Herm., 1804, nec N., 1818; *Liotheum* N., 1818, nec Neum., 1906; *Physostomum* N., 1818).—*R. fringillæ* Deg.
19. *Colpocephalum* N., 1818 (syn. *Liotheum* Neum., 1906, nec N., 1818).—*C. zebra* N.
20. *Menopon* N., 1818 (syn. *Eureum* N., 1818).—**M. gallinæ* L. (syns. *M. trigonocephalum* Olfers; *M. pallidum* N.).
21. *Trinoton* N., 1818.—**T. anseris* Sulzer (syn. *T. conspurcatum* N.).
22. *Læmobothrion* N., 1818.—**L. maximum* Scop. (syn. *L. giganteum* N.).
23. *Boopia* Piaget, 1880.—*B. tarsata* Piag.
24. *Dennyus* Neum., 1906 (syn. *Nitzschia* Denny, 1842, nec v. Baer, 1827).—*D. burmeisteri* Denny (syn. *N. pulicaris* N., in Giebel, 1874).
25. *Ancistrona* Westwood, 1874.—*A. procellariæ* Westw.
26. *Piagetiella* Neum., 1906, (syn. *Piagetia* Picaglia 1885, nec Ritsenia).
27. *Heterodoxus* Le Souëf & Bullen, 1902.—*H. macropus* Le Souëf & Bullen.
28. *Latumcephalum* Le Souëf, 1902.—*L. macropus* Le Souëf.

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1835, DUFOUR—Ann. Soc. Ent. France, iv., 1835.
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† Called *Liotheinæ* in Neumann (1906, pp. 58, 60). *Ricinidæ* is the more correct designation, as the name refers to a family whose type-genus is *Ricinus*.

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1866, Rudow—Zeitschr. f. ges. Naturwiss. xxvii., 1866, p.466.
1870, ——— ,, ,, xxxv., 1870, p.138.
1905, Stiles—Bull. 24, Hyg. Lab. Publ. Health & Mar. Hosp. Service, U.S.A.
1882, Taschenberg—"Die Mallophagen etc.' Nova Acta, Halle, xliv., 1, 1882.

Postscript, added 15th July, 1910.—After this paper was read, we came upon a reference in Kellogg(1896, p.164) which gives the generic characters of *Piagetia*, *P. ragazzii* Picaglia, being the type. This parasite is certainly congeneric with *Menopon titan* Piaget, and *Tetrophthalmus chilensis* Grosse(Zeit. f. wiss. Zool., xlii., 1885, p.534). As Grosse's genus *Tetrophthalmus* antedates Picaglia's *Piagetia*, which name is, moreover, already preoccupied, as Neumann has pointed out, Grosse's genus must stand (with *T. chilensis* as type), and *Piagetia* Picaglia, as well as *Piagetiella* Neumann, must rank as synonyms. We refrain at present from commenting upon the individuality of *T. chilensis*, and the various other species and subspecies of the *titan*-group (*T. titan*, Piag., *T. ragazzii* Pic., *T. consanguineus* Piag., *T. linearis* Kell., and *T. impar* Kell.).

According to the ruling of the International Commission, Grosse's genus *Tetrophthalmus* is not invalidated by *Tetrophthalma* Less., 1833(Coleoptera), and *Tetraophthalmus* de Haan, 1834 (Coleoptera).

NOTES ON VARIABLE DIŒCISM IN *PITTOSPORUM UNDULATUM* Andr.

By Thos. Steel, F.L.S.

(Plate ix.)

In 1894[*] and again in 1895,[†] Mr. A. G. Hamilton drew attention to the fact that two types of flowers are to be found on *Pittosporum undulatum* Andr.; the one sort having prominent stamens, the anthers being well developed and carrying abundance of pollen; while the other has the stamens undeveloped, the anthers being non-dehiscent, and closely appressed to the base of the ovulary. Mr. Hamilton concludes that the plant is in a state of transition to a diœcious condition, and remarks that he has never found the two kinds of blossom on one tree.

In 1898,[‡] Mr. Hamilton again referred to the differentiation of sexes in this tree, and observed that the staminiferous form apparently never sets seed, while in the case of another Australian species, *P. revolutum* Ait., the flowers are always perfect. Mr. T. Kirk,[§] speaking of a New Zealand species, *P. eugenioides* A. Cunn., states that both kinds of flowers are found, and may either be produced on separate trees, or both forms may occur on the same tree.

Mr. J. J. Fletcher, in 1900,[‖] drew the attention of members of this Society to the possible occurrence of both kinds of blossom on one tree.

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[*] Proc. Linn. Soc. N. S. Wales, 1894, p.583.

[†] Aust. Assocn. Adv. Science, 1895, p.405.

[‡] Proc. Linn. Soc. N. S. Wales, 1898, p.759.

[§] Forest Flora of New Zealand, 1889, p.81.

[‖] Proc. Linn. Soc. N. S. Wales, 1900, p.543.

Again, in 1902, Mr. R. H. Cambage* brought evidence forward confirmatory of the observations made by the previously quoted botanists. During the last few years I have had opportunities of making close observations on several trees of *P. undulatum* growing in my garden, at Petersham, near Sydney, and on numerous others in gardens in the vicinity, which have yielded further information of an interesting nature.

Usually towards the end of June, in the neighbourhood of Sydney, the flower-buds on the male or staminiferous trees are well advanced, many of them being on the point of opening, while on the female or non staminiferous trees nothing but leaf-buds are visible. The blossoms on the latter begin to open about three weeks or a month later than the others, and are accompanied by a succession of staminiferous flowers on the adjacent male trees during the whole period of flowering. The male trees are much handsomer than the female, because of the larger size of the blossoms and the bright yellow of the anthers; while both are fragrant, secrete nectar and are freely visited by bees.

I have repeatedly noticed a few seed-vessels occurring, either solitary or in clusters, on the male trees, and have ascertained by trial that the seed contained in these is fertile and germinates as readily as that from the female trees. In normal blossoms, when fully open, the ovary of the staminiferous type, though of about equal length to that in the female flower, is not nearly so stout and globose; while the stamens are long, and have the anthers projecting above the top of the pistil(Pl. ix., figs.2-3). In the female flowers, as has been very clearly described by Mr. Hamilton, the stamens are mere rudimentary scales appressed to the base of the ovary(Pl.ix., fig.5). With the aid of my sons, I have, in several successive years, made a close examination of many hundreds of blossoms on both kinds of tree; and have found, on the male tree, blossoms having short stamens, with shrivelled abortive anthers which did not dehisce or form pollen. By marking these with little pieces of cord tied round the petioles, I was able to keep them under observation, and found that these were the blossoms which gave rise to the fruits noticed on the male trees. The abnormal blossoms, though by no means easy to find amongst the multitude of others, are readily identified when seen, because of the absence of visible anthers. The stamens in these blossoms are not like those in the female flowers, but are about one-half the normal length, reaching to about the top of the ovary, and, as has been mentioned, are non-dehiscent (Pl.ix., fig.7). The ovary in the abnormal blossoms is, in size and shape, quite different from that in the ordinary male blossoms, but precisely like that in the female. On no occasion have we found a staminiferous blossom on a female tree, although we have searched carefully.

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* Proc. Linn. Soc. N. S. Wales, 1902, p.593.

The abnormal or fruit-setting blossoms on the male trees are erratically developed, sometimes only one in a cluster, at other times two, three, four, or even a full cluster, but they are never abundant. Intermediate blossoms are met with occasionally. One example, which I have carefully preserved and which was on a male tree, contained two normal stamens, two abortive, and one intermediate (Pl.ix., fig.6); while the ovary had the small, slender shape normal in male blossoms.

We thus see that, while the trees have differentiated into the diœcious state, the male trees have occasional female flowers which retain abortive stamens, and, more rarely, single blossoms which may be considered intermediate in having some normal and some abortive stamens; the female trees appear never to have any but normal female blossoms.

The normal number of petals in each blossom is five. Variations are exceedingly rare, and I have noticed only two examples, one of which chanced to be a male, and the other a female blossom. The former possessed only four petals and stamens, while the latter had six petals and a like number of the small, scale-like, undeveloped stamens.

It would be interesting to know whether the seeds derived from male trees show any predisposition to produce male or female plants, and with this object in view, in 1906, I gave Mr. Maiden a quantity of seed which I had watched ripen on the male tree. This grew freely, but unfortunately through some mishap all the plants but five were lost sight of. These, however, are now growing in the Palace Ground section of the Botanic Gardens, Sydney; they have not yet flowered, but will be kept under observation. I shall endeavour to give Mr. Maiden a fresh supply of similar seed, and it is proposed to continue the experiment.

For the drawings in illustration, I am indebted to my friend, Mr. R. T. Baker.

I am placing the illustrative specimens in the National Herbarium, Sydney.

EXPLANATION OF PLATE IX.

Pittosporum undulatum Andr.

Fig. 1.—Flowering twig, male tree, showing A, normal, not producing seed, and B, abnormal flowers which produce seed.

Fig. 2.—Normal male flower showing anthers.

Fig. 3.—Normal male flower, dissected.

Fig. 4.—Abnormal seed-producing flower, male tree, dissected.

Fig. 5.—Normal female flower, dissected.

Fig. 6.—Intermediate flower, male tree, showing two normal and three abortive stamens, corolla removed.

Fig. 7.—Abnormal flower from male tree, showing short abortive stamens, corolla removed.

Fig. 1 natural size. Fig. 2 slightly enlarged. Figs. 3, 4, and 5 considerably enlarged.

ON A COLLECTION OF PARASITIC HYMENOPTERA (CHIEFLY BRED), MADE BY MR. W. W. FROGGATT, F.L.S., IN NEW SOUTH WALES, WITH DESCRIPTIONS OF NEW GENERA AND SPECIES. PART i.

BY P. CAMERON.

(Communicated by W. W. Froggatt.)

This paper may be looked upon as a continuation of one by the late Dr. Wm. H. Ashmead, published in the Society's Proceedings for 1900; and is of the same nature, dealing, as it does, with Parasitic Hymenoptera caught, and more particularly, bred by Mr. Walter W. Froggatt, F.L.S., the Government Entomologist. Some of the bred species may prove to be of economic importance, as, for example, *Opius tryoni*, reared from the Dipterous fruit-fly, *Dacus tryoni*. Of geographical interest is the occurrence in Australia of a species of *Philopsyche*, a genus hitherto known only from Ceylon, in which island is to be found, it is to be noted, a species of the Australian genus *Lissopimpla*.

CRYPTINÆ.

ERYTHROMESOSTENUS, g.n.

Head wider than thorax, which is thrice longer than wide: parapsidal furrows distinct on the basal two-thirds. Scutellum hardly raised above mesonotum, the sides keeled to beyond the middle. Metanotum with distinct lateral spines, a transverse basal keel; metapleuræ with a complete keel, the spiracles small, longish-oval, areolet punctiform, open at apex, recurrent nervure received shortly beyond transverse cubital; transverse median almost interstitial; disco-cubital nervure roundly curved, unbroken; transverse median nervure in hind wings broken near middle. Post-petiole broad, spiracles separated from each other by a greater distance than they are from the apex; abdomen entirely smooth: second segment as wide at apex as it is long. Legs long and particularly the hinder, tarsi longer than tibiæ, claws small; antennæ slender for the group, third joint a little longer than fourth.

Allied to *Mesostenoideus*, *Skeatia*, and *Christolia*. It may be known by the red-coloured body, the smooth abdomen, the minute areolet, open at the apex, and by the transverse median nervure in the hind wings being broken in the middle, not distinctly below the middle as in the genera just mentioned. Red is an unusual colour in the Mesostenini.

ERYTHROMESOSTENUS RUFUS, sp.n.

♀. Rufous, antennæ black, scape rufous, 6th to 14th joints white; wings hyaline, stigma and nervures black, areolet punctiform, apical nervure obsolete; apex with a faint, narrow smoky border; transverse median nervure semi-interstitial; transverse median nervure in hind wings broken in the middle, sharply angled in the middle. Tips of mandibles black. Palpi dark red. Length, 8; terebra, 3 mm.

Wollongbar, Richmond River, N.S.W. Bred from "Fern-Moth larva."

Face roundly raised in middle, closely punctured there, sides smooth, separated from clypeus by a shallow furrow; clypeus closely finely punctured on upper half, smooth on lower. Malar space almost as long as antennal scape. Temples very short, rounded; occiput transverse. Metanotum smooth, parapsidal furrows deep, reaching from base to base of apical third. Scutellum smooth, sides strongly keeled to top of apical slope. Metanotum at the base to the keel; the rest closely reticulated, more strongly so towards apex, where, on the sides, they are stronger than in the middle and more longitudinal; spines short, thick, rounded. Propleuræ irregularly striated, smooth in middle above, striæ at base below stronger and more curved. Mesopleuræ strongly, closely, irregularly reticulated, more strongly and obliquely at base above, the apex above smooth. Metapleuræ above strongly reticulated, above the keel the striæ are stronger and oblique; below the keel more finely and regularly reticulated; spiracles small, longish-oval. Abdomen smooth and shining; petiole becoming gradually widened to base of postpetiole, which is smooth, of equal width and a little wider than long.

POECILOCRYPTUS NIGRO-MACULATUS Cam., Ann. Mag. Nat. Hist. vii.(7), June, 1909, 528.

Near Inverell, N. S. W.; in September. Bred from reddish (Eucalyptus) berry-shaped galls (W. W. Froggatt).

I am not sure that *Pœcilocryptus* can be referred to the *Cryptinæ*. The spiracles on the first abdominal segment are placed nearer the middle than they are in that group; the mesonotal and mesopleural furrows are shorter, and less clearly defined than in the typical *Cryptinæ*. The legs, too, and especially the hinder, are shorter and thicker, being more as they are in the *Pimplinæ*. From the latter, it differs in the basal abdominal segment being longer and more slender, with the spiracles placed nearer the middle. My present opinion is to refer it to the *Pimplinæ*, in or near the *Lissonotini*. The form of the abdomen, which is not compressed laterally, separates it from the *Ophionini*.

OPHIONINÆ.

LIMNERIUM BOMBYCIVORUM, sp.n.

♀. Black, legs entirely lemon-yellow, femora deeper in tint than tibiæ, palpi and tegulæ of a paler yellow colour, wings clear hyaline, stigma and nervures black; areolet absent; cubitus obliquely bent down from the transverse cubital; transverse median nervure received shortly beyond transverse basal. Head and thorax opaque, covered with short white pubescence; abdomen smooth, bare and shining. Length 7 mm.

Tasmania (A. Morton). A parasite on Bombyx larva.

Head wider than thorax, wide, sharply obliquely narrowed. There is a stout transverse keel on the base of the metanotum, roundly bent towards base in middle. Abdomen much more shining than thorax, and smoother. Metanotum more densely pilose than the rest of thorax.

LIMNERIUM TASMANIENSE, sp.n.

♀. Black, second and following segments of abdomen ferruginous, base of second segment narrowly, the sides more broadly black, second and third ventral segments yellowish, with black lateral spots; legs ferruginous like the abdomen, coxæ and basal joint of trochanters black, apical joint of the latter yellow, apex of hind tibiæ and of tarsal joints infuscated; wings hyaline, stigma and nervures fuscous, areolet appendiculated, pedicle a little shorter than first transverse cubital nervure, recurrent nervure received shortly beyond its middle. Length, 5; terebra, 1 mm.

Hobart Town, Tasmania (A. M. Lea).

There are two curved keels on the base of the metanotum, forming almost semicircular areæ, but the keels on the outer side do not extend to the base of the metanotum. Head and thorax covered, not very densely, with a white pile. Abdomen broader than usual. Eyes converging only slightly above, hinder ocelli separated from each other by the same distance as they are from the eyes. Transverse median nervure received shortly beyond transverse basal.

HYMENOBOSMINA VERIMACULATA, sp.n.

♀. Yellowish-testaceous, abdomen more rufous in tint; a broad band, twice the width of the yellow orbital part, on front and vertex, slightly obliquely narrowed behind ocelli, occiput except at outer edges, a wide mark on basal half of mesonotum in the centre, a thinner one on sides, narrowed at apex to a fine point; scutellar depression, basal half of the narrowed base of first abdominal segment, a broad line down basal two-thirds of second segment and basal fourth of the third black; wings hyaline, stigma and nervures black; recurrent nervure received at half the length of the transverse cubital beyond it; transverse median nervure interstitial; legs testaceous, tinged with rufo-fulvous, base of hind tibiæ, their apex more broadly, and hind tarsi blackish. Length, 10mm.

Medowie, New South Wales; in April. Parasite on "Case-Moth," *Thyridopteryx hübneri*(W. W. Froggatt).

Head and thorax closely punctured, covered with a short white down; middle of metanotum closely transversely striated, more strongly in middle, this part being bordered almost by keels, forming an elongated area of equal width. Second abdominal segment closely longitudinally striated.

On the same card as the specimen described above is a male, which agrees with the female in the colouration of the head and thorax, except that the scutellum is surrounded with black; the metanotum entirely black, as are also the upper two-thirds of the mesopleuræ; an elongated conical spot on the base below, the base of the metapleuræ, narrowly above, more broadly below; the basal abdominal segment is entirely black, the second with the basal three-fourths above, almost the basal half of the third, and the apical two entirely black.

PIMPLINÆ.

PHILOPSYCHE PILOSELLA, sp.n.

♂. Black, densely covered with white hair, which is longer and denser on sides of scutellum and metathorax, and, to a less extent, on face, underside of antennal scape, tegulæ, a spot on pronotum in front of them, palpi and four front legs bright lemon-yellow; hinder trochanters, basal three-fourths of hind tibiæ, basal two joints of hinder tarsi except at apex, and apices of basal segments of abdomen broadly, whitish-yellow; band on second segment slightly and roundly incised in middle at base; third, fourth, and fifth, more widely and squarely incised in middle; second, third, and fourth, with a black spot on sides of the band; second with a triangular yellow spot, at base laterally, of the same colour. Wings hyaline, iridescent, stigma and nervures black, areolet almost appendiculated in front, recurrent nervure received at apex; transverse median nervure interstitial. Length, 10mm.

Mittagong, N.S.W.: in January (W. W. Froggatt).

Head smooth, upper part of thorax closely punctured, except for a smooth space in middle of metanotum at base; pleuræ almost impunctate; abdomen, except the last segment, more strongly and quite as closely. Basal slope of first abdominal segment obliquely sloped, and margined on sides of slope, which is narrowed above.

This species is very similar in colouration and clothing of the body to the type of the genus, *P. albobalteata* Cam., from Ceylon, which is, as the name denotes, a parasite on the moth *Psyche*. The small black spot on the sides of the bands on the second to fourth segments is also present in the Ceylonese species, but the colouration of the legs in that is very different; and it is smaller.

BRACONIDÆ.

Braconinæ.

Platybracon nigriceps, n.sp.

♀. Rufo-luteous; antennæ, head, hinder tarsi, and sheath of ovipositor black; mandibles, except the tips, and tarsi rufo-testaceous; wings rufo-testaceous to near the transverse basal and transverse median nervure, dark fuscous beyond, except the greater part of the first cubital cellule, the blackish part in the apex of the latter being triangular; a small hyaline cloud running along outer part of stigma from the commencement of the black apical part to the radius; stigma yellowish-ochraceous, apical fourth black; third abscissa of the radius as long as the basal two united, second cubital cellule thrice longer than wide; recurrent nervure received in the apex of first cubital cellule. Central part of first abdominal segment and centre of lateral finely, closely striated; second, third, and fourth more strongly striated, except on lateral basal areæ, which are smooth and bounded by crenulated furrows; first area the larger, and transversely triangular; second smaller, and more semicircular in shape; third still smaller. Suturiform articulation deep, crenulated; there are narrower, crenulated furrows near apex of third and fourth, the extreme apex being smooth. Length, 11; ovipositor, 8 mm.

Gin Gin, Queensland; on 13th October (W. W. Froggatt).

The plate below the antennæ is short, broad, rounded, and with a broad keel down the middle; the face is shagreened, depressed on either side of the middle. Face with a few long black hairs; oral region and lower part of head densely with longish white pubescence. Legs densely covered with white hair. Black cloud at base of transverse basal nervure roundly incised, before transverse median obliquely narrowed below.

BRACON FROGGATTII, sp.n.

♀. Black, shining, pro- and mesothorax with scutellum red, sides of first abdominal segment white; covered, especially above, with white pubescence, which is longer on thorax than on back of abdomen; legs black, densely covered with short white pubescence. Wings uniformly dark fuscous, stigma and nervures black; basal two abscissæ of radius united as long as third; second cubital cellule four times longer than wide; recurrent nervure interstitial. Length, 5; terebra, 1 mm.

Reedy Creek, near Inverell; in September (W. W. Froggatt).

First abdominal segment about thrice longer than wide, roundly curved, central black part of equal width; it is fully one-quarter longer than second, which is wider than long. It has a smooth keel, triangularly dilated at base on basal half; suturiform articulation distinct, crenulated and without a distinct apical lateral branch; it is the only furrow. Parapsidal furrows narrow but distinct, extending from base to apex. Malar space two-thirds of length of eyes. Head narrower than eyes, temples obliquely narrowed.

BRACON EUCALYPTI, sp.n.

♂ ♀. Black; head, underside of antennal scape, prothorax, basal three abdominal segments, and the four front legs pale rufo-testaceous; wings hyaline, very iridescent, stigma and nervures black. Length, 3; terebra, 1mm.

Sydney. Bred from reddish galls on leaves of *Eucalyptus* sp. (W. W. Froggatt).

Smooth and shining, sparsely covered with white pubescence, legs more densely so than body. Apical abscissa of radius about one-third longer than the basal two united; recurrent nervure received in apex of first cubital cellule; second cubital cellule about thrice longer than wide. The colouration of the legs varies: the middle may be marked with black and the hinder with testaceous.

CHELONINÆ.

AREOGASTER ERYTHROPUS, sp.n.

♀. Black; scape of antennæ and legs red, hind coxæ black at base to shortly beyond middle; covered with a white pile which is longer and denser on metanotum; palpi pale testaceous; wings hyaline, costa pale testaceous, stigma and nervures black. Length, 5 mm.

Mittagong, N.S.W.; on 14th October (W. W. Froggatt).

Basal joint of flagellum obscure brown Head closely distinctly, but not very strongly punctured, front and vertex less strongly than the face, which is separated from the clypeus by a rounded, clearly defined furrow. Thorax closely, distinctly punctured, apical half of mesonotum irregularly reticulated. Scutellum more strongly and less closely punctured than mesonotum; a row of deep foveæ, almost square, at the base. Abdomen alutaceous, base irregularly longitudinally striated.

CHELONUS MEGASPILUS, sp.n.

♀. Black; a large white mark, about one-half longer than wide, sides straight, base and apex transverse, apex wider than base; on basal third of abdomen; legs red, coxæ and trochanters black; wings highly iridescent, tinged with fuscous to the stigma, apex hyaline, stigma and nervures black. Length, 3 mm.

Tamworth, N.S.W. (W. W. Froggatt).

Antennæ longer than body, at least 33-jointed; face closely, minutely punctured, clypeus more shining, clearly separated; both are covered with short white pubescence. Mesonotum weakly, irregularly punctured, outer edge irregularly striated. Base of propleuræ smooth and shining, apex shagreened. Meso- and metapleuræ shagreened, irregularly reticulated. Mesosternum shining, punctured, the middle less strongly than sides. Abdomen shagreened, base irregularly striated.

METEORINÆ.

PROTELUS LUTENS, sp.n.

♀. Luteous, abdomen paler in colour, antennæ infuscated beyond middle; wings hyaline, stigma fuscous, paler at base, nervures black; second cubital cellule narrowed slightly, but distinctly in front; first abscissa of radius half the length of second. Face closely, minutely punctured, densely covered with short white pubescence; front and vertex smooth and shining; a semicircular depression, flat in centre, over each antenna. A shallow, finely rugosely punctured depression in middle of apical half of mesonotum, its base triangularly projecting at sides; it is slightly, gradually narrowed towards apex; apex of mesonotum at sides smooth, shining and narrowed towards base. Scutellar depression large, deep, base rounded, middle with a keel, and with two short keels on either side at apex. Metanotum irregularly reticulated, more closely and regularly at apex, base with a keel down middle. Abdomen smooth, post-petiole finely striated. Length, 5 mm.

Sydney, N.S.W. Bred from the larva of a moth, *Teara* sp. (W. W. Froggatt).

MICROGASTERINÆ.

APANTELES PHILŒAMPUS, sp.n.

♀. Black; basal two ventral segments pallid testaceous, legs rufous, coxæ, apex of hind femora narrowly, of hind tibiæ more broadly and hind tarsi, black; wings hyaline, nervures and stigma fuscous. First abdominal segment almost one-fourth longer than wide at apex; second a little more than one-half length of third. Metanotum in one example with a not very distinct keel down middle; it is probably not always defined. Sheath of ovipositor short, broad. Length, 3 mm.

Wattle Flat, N.S.W.; in January. "Bred from a caterpillar"(W. W. Froggatt).

Head shining, smooth, almost bare. Thorax above densely covered with white pubescence, which is denser and longer on metathorax. Mesonotum closely, distinctly punctured; scutellum gradually narrowed to a point. Metanotum more opaque, coarsely alutaceous, as are also, but less strongly, the basal two abdominal segments. Third abdominal segment a little shorter than first, fourth not quite one-half the length of third, and slightly shorter than second.

APANTELES SYDNEYENSIS, sp.n.

♀. Black; legs rufous-testaceous, base of middle coxæ, posterior entirely and apex of hind femora narrowly, black; apex of hind tibiæ infuscated. Wings hyaline, stigma and nervures pallid, testaceous. Antennæ almost fuscous. Metanotum coriaceous, opaque, not keeled. Basal two abdominal segments opaque, alutaceous, finely, irregularly, obscurely, longitudinally striated; first segment not much longer than it is wide at apex; second about one-half its length; third a little shorter than it. Ovipositor short. Length, 2 mm.

Head more shining than thorax which is opaque, mesonotum finely, closely, rugulosely punctured; scutellum more distinctly punctured, the punctures being more clearly separated. Metanotum more coarsely sculptured than any other part of the body.

Sydney. Bred from a small green caterpillar, perhaps a *Plusia;* in June (W. W. Froggatt). Cocoons longish-oval, clear white and covered with white hair. A chalcid hyperparasite was bred from the cocoons.

OPIINÆ.

OPIUS TRYONI, sp.n.

♂. Head, scape, basal joint of flagellum, and thorax rufoluteous, the four front legs of a paler luteous colour, hind legs fuscous, coxæ paler, femora darker in tint; abdomen whitish, central part of first abdominal segment above and the others except narrowly at apex, black; wings clearly hyaline, iridescent, stigma fuscous, nervures blackish, first abscissa of radius one-fourth of length of second, which is a little longer than first transverse cubital nervure; recurrent nervure received near apex of first cubital cellule; first abscissa of cubitus roundly curved towards costa; second cubital cellule along the cubitus a little more than twice the length of second transverse cubital nervure. Length, 3 mm.

Narara, N.S.W.; in November. Bred from the pupæ of *Dacus tryoni*, a Dipterous fruit-fly.

This is the parasite bred out of the maggots of the Queensland fruit-fly infesting the berries of the White Ash (*Schizomeria ovata*) by Messrs. Gurney and Gallard, and figured and described by Gurney in the Agricultural Gazette of New South Wales, 1910, p. 428.

Antennæ almost double the length of the body, which is smooth, shining and almost bare. Clypeus clearly separated from face by a distinct, rounded furrow, which is widened and deepened on the lower edge. Tips of mandibles black. Parapsidal furrows deep, mesonotum trilobate. Metanotum less shining than mesonotum; a stout keel down centre. Mesopleural furrows not very distinct, smooth. Antennæ at least 43-jointed, flagellum closely pilose. Both the basal two abdominal segments are longer than wide.

On the whole, this species agrees best with *Opius*, but it approaches *Biosteres* closely in the alar neuration. The relative size of the stigma, and the relative length of the abscissæ of the radius do not afford very definite generic characters. It is to be noted that the late Dr. W. H. Ashmead (These Proceedings, 1900, p. 357) records *Diachasma carpocapsæ*, Ashm., from New Zealand, as a probable parasite of *Dacus tryoni*.

EVANIIDÆ.

AULACINUS PALLIDICAUDIS, sp.n.

♂ ♀. Black; antennæ, apex of the four front femora, four front tibiæ, and tarsi, rufo-testaceous; middle joints of flagellum paler, more yellowish in colour; base of hind tibiæ and apex more narrowly, rufo-testaceous, as are also, except at apex, the mandibles; wings hyaline, iridescent, apex with a narrow smoky border, stigma and nervures black; second transverse cubital nervure paler than the others, second recurrent nervure received very shortly beyond it, third at a greater distance before first; first abscissa of radius with a steep, oblique slope, and a little shorter than third, second shorter than either. Sheaths of ovipositor pale fulvous, darker at base. Length, 8; terebra, 7 mm.

Head smooth, opaque, wider than thorax, temples a little longer than eyes, rounded behind; occiput rounded. Hinder ocelli separated from eyes by one-half more than from each other. Third joint of antennæ a little shorter than the fourth. Palpi testaceous, basal joints blackish. Mesonotum and scutellum irregularly reticulated, the former more strongly towards apex; parapsidal furrows distinct, straight, oblique; striæ on scutellum transverse, an opaque, non-striated space on middle of apex. Metanotum in centre alutaceous, sides with curved striæ; the rest closely reticulated, more finely on sides of metapleuræ. Pro- and mesopleuræ opaque, finely rugose, a clearly defined striated band down apex of propleuræ, bounded by keels at base and apex; reaching to shortly below the middle; a similar, but wider band down apex of mesopleuræ, with the striæ longer and more widely separated, and bounded behind by a keel. Abdomen smooth, first segment longer than the others united, curved, becoming gradually dilated, obliquely upwards towards apex; ovipositor nearly as long as body.

Comes near to *A. planiceps*, Szep., and *A. biroi*, Szep.; the former has the sheaths of the ovipositor black; the latter has them whitish only before the end, and the base of the abdomen is red.

Rose Bay, Sydney. Bred by Mr. W. W. Froggatt, from the larva of *Piesarthrius marginellus*. *Aulacus apicalis*, Westw., is a parasite of the same species (*cf.* W. H. Ashmead, These Proceedings, 1900, p. 348).

AULACUS FUSCICORNIS, sp.n.

♀. Black; antennæ fuscous; legs except the hind coxæ, and abdomen except base above and sides to below the middle, red, the black only on the narrowed part; wings clear hyaline, nervures and stigma black; third abscissa of radius a little longer than second; second recurrent nervure received almost in middle of cellule; second transverse cubital nervure widely bullated. Length, 6; terebra, 7 mm.

Sydney. Bred from the larva of a Longicorn beetle (W. W. Froggatt).

Antennæ as long as head and thorax united, stout, basal two joints red, third about one-quarter longer than fourth. Front opaque, punctured, more or less reticulated; vertex finely, closely, transversely striated at ocelli; sides at ocelli almost impunctate, the rest punctured, but not closely, the punctures being clearly separated. Mesonotum transversely rugosely reticulated, the longitudinal striæ finer than the transverse. Scutellum rather strongly transversely striated; post-scutellum finely transversely striated. Base of metanotum depressed, and with some longitudinal striæ; the rest irregularly reticulated. Base of propleuræ opaque, closely irregularly reticulated, the rest aciculated, irregularly punctured, the depressed central part rather strongly striated below. Upper part of mesopleuræ closely, irregularly reticulated and aciculated, the rest obliquely striated, more widely below than above. Metapleuræ closely irregularly punctured above, base above middle with a smooth oblique, shining space, the rest obliquely. Closely reticulated-striated.

ORDINARY MONTHLY MEETING.

JULY 26th, 1911.

Mr. W. W. Froggatt, F.L.S., President, in the Chair.

Messrs. ERNEST J. BICKFORD, Randwick; JOHN LEWIS FROGGATT, Croydon; HEBER A. LONGMAN, Queensland Museum, Brisbane; and HENRY S. H. WARDLAW, Darlinghurst, were elected Ordinary Members of the Society.

The Donations and Exchanges received since the previous Monthly Meeting (28th June, 1911), amounting to 61 Vols., 78 Parts or Nos., 17 Bulletins, 2 Reports, and 17 Pamphlets, received from 55 Societies, &c., and two Individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. L. Harrison exhibited photographs of the yellow-breasted robin (*Eopsaltria australis* Lath.) on the nest; and of the male bird belonging to this nest in the act of feeding the young of the white-shafted fantail (*Rhipidura albiscapa* Gould), which were in a nest close by.

Mr. A. R. McCulloch exhibited, by permission of the Curator of the Australian Museum, six fishes collected at Murray Island, Torres Strait, none of which appeared to have been previously recorded from Australian waters, though all were well known Indian and Pacific Ocean species. They were *Synanceja verrucosa* Bl. Schn., *Thalassoma dorsale* Q. and G., *T. janseni* Bleeker, *Parapercis hexophthalma* Cuv. and Val., *Amblygobius phalæna* Cuv. and Val., and *Stephanolepis melanocephalus* Bleeker.

Mr. A. A. Hamilton exhibited specimens of, and offered observations on, two grasses, *Panicum glabrum* Gaud., and *Digitaria didactyla* Willd., of which the former has acquired a somewhat complicated synonymy.

Mr. Cheel exhibited specimens of *Atylosia grandiflora* F.v.M., [LEGUMINOSÆ: North Australia and Queensland], grown from seeds found mixed with some "Mauritius Beans" (*Stizolobium aterrimum* Piper and Tracy) forwarded to the Director of the Sydney Botanic Gardens, from the Macknade Mill, Herbert River, North Queensland. The plants grew to a height of from 4-7 feet, and were very showy; but were killed off by the frosts of last May, before setting seed. Mr. Cheel showed also specimens and seeds of six other species of *Stizolobium*—*S. hasjoo* Piper & Tracy (Yokohama Bean), *S. Deeringianum* Bort. (Florida Velvet Bean), *S. utile* (Wall), *S. capitatum* (Roxb.) Kuntze, *S. niveum* (Roxb.) Kuntze (Lyon Bean), and *S. pachylobium* Piper & Tracy (Fleshy-pod Bean)—all from plants grown at Penshurst, from seeds supplied to the Director of the Botanic Gardens, Sydney, by Mr. F. C. Piper, of the United States, who has published a very important paper on the group.

Mr. Cheel likewise exhibited an original specimen of *Persoonia media* R.Br., from the National Herbarium, Sydney, collected by Dr. Beckler, on the Hastings River, as recorded by Bentham in the Flora Aust., for comparison with the specimens from the Blue Mountains shown by Mr. Fletcher at the previous meeting.

Mr. Fletcher remarked that, on referring to the Supplement to the Prodromus (p.16) he had found that the type-specimens of *Persoonia media* R.Br., were collected by Fraser on the Blue Mountains in 1818, "Loc. Ora orient., mont. prope Port Jackson, 1818. D. Fraser." Mr. Bentham, however, apparently inadvertently, omitted to mention the type-locality in the Flora Aust., and this had dropped out of notice. As the specimens from the Blue Mountains, so far as seen, had the ovary glabrous, whereas in those from the Northern Rivers in the National Herbarium examined by Mr. Cheel the ovary was hirsute, it was a matter for investigation whether the difference in the character of the ovary was not something more than a casual variation, and also whether Mr. Bentham had not incorrectly assigned the Northern River and Queensland specimens to *P. media* R.Br.

Mr. Froggatt showed a number of pear-shaped and of round, earthern egg-cases of Scarabeid Beetles, from Rockhampton, Queensland, found under logs, the smaller, globular cases being those of *Cephalodesmus* sp.

ON PARASITIC HYMENOPTERA FROM THE SOLOMON ISLANDS, COLLECTED BY MR. W. W. FROGGATT, F.L.S.

By P. Cameron.

(Communicated by W. W. Froggatt.)

The Hymenoptera collected by Mr. Walter W. Froggatt, F.L.S., during his visit to the Solomon Islands, in July and August, 1909, number 17 (*Chalcididæ* 2, *Braconidæ* 6, *Evaniidæ* 1, *Ichneumonidæ* 8), all undescribed. Taking into consideration that the Parasitic Hymenoptera of these Islands are practically unknown, and that we know comparatively little about the Parasitic Hymenoptera of Papua, this fact is not to be wondered at.

As regards the geographical relationship of the species, *Chalcis*, *Bracon*, *Chelonus*, *Agathis*, *Eristicus*, *Mesostenus*, and *Henicospilus* are genera of general distribution over the globe. *Platybracon* is distributed over Malaya, and is found also in Australia. *Lissopimpla* is found in Ceylon and Australia. *Echthromorpha* is noted for its wide range over Oceanic Islands, but is also common in Hindu-Malaya. *Pegarthrum* is probably an Austro-Malay genus. *Megischus* has an extensive range over Hindu-Malaya, and Austro-Malaya, being probably commoner in the islands than on the main lands.

CHALCIDIDÆ.

Chalcididinæ.

Chalcis salomonis, sp.n.

♂. **Black**; covered with silvery pubescence, basal segments of abdomen bare, and more shining than apical; tegulæ, apex of the four front femora, their tibiæ and tarsi, except the tibiæ, broadly black behind, and the posterior behind, except at the base; hind tarsi testaceous; femora with about ten teeth, the basal smaller, less clearly separated than the others, those below the middle larger; apex of scutellum broadly rounded. Metanotum strongly reticulated, areola thrice longer than wide, narrowed towards base and apex, keels uniting at base, separated at apex, the apical keel being transverse. Wings clear and hyaline, nervures black. Length, 4 mm.

Head in front opaque; face without an area, shagreened, a smooth line down middle of face. Frontal depression smooth, deep, roundly narrowed above. Mesonotum and scutellum umbellically punctate. On the top of the propleuræ is a large, shallow, rounded fovea, with a flat, smooth keel projecting from its middle behind; below are two or three weakly defined foveæ. There are four foveæ down the base of the mesopleuræ, the upper the longer, and with a smooth, flat, broad keel narrowed at the top above them; behind the middle is a shining aciculated area, commencing at the top, but not reaching to the bottom, wider above than below, the lower part with the apex rounded. Metapleuræ opaque, coarsely alutaceous, irregularly reticulated.

Cleonyminæ.

ARESSIDA, gen. nov.

Antennæ slender; flagellum of uniform thickness, placed immediately over mouth, a curved keel beneath them. Malar space nearly as long as eyes, which are large, and converge distinctly above. Antennal scape in grooves, which unite above, scape projecting over the grooves. Temples much narrowed above, becoming gradually widened below. Prothorax large, well-developed, widened towards apex, where it is as wide almost as the total length; keeled down middle. Parapsidal furrows obsolete, mesonotum slightly depressed in middle at apex. Scutellum large; base narrowed, transverse; sides obliquely narrowed; apex broad, rounded, slightly projecting, and with a crenulated furrowed margin.

Metanotum short in centre, sides larger, rounded legs of moderate length, hinder femora thicker than anterior, which are roundly incised at apex below; fore and hind coxæ more than twice longer than thick, the hinder the longer. Wings banded; basal vein long, about one-fourth longer than marginal, which is thickened at apex; stigmal vein short, curved, thickened at apex; postmarginal extening to apex, but becoming faint towards the end. Abdomen sessile, basal segment the larger, all the segments transverse at apex, becoming gradually narrowed; last segment produced into a stylus as long as the preceding three segments united; ovipositor projecting half its length beyond this.

Belongs to the *Cleonyminæ*. It should be known by the anterior femora not being swollen, and by their being roundly incised at the apex; by the pronotum being keeled down the middle; by the transverse abdominal segments; and by the long, projecting ovipositor-like last segment. The form of the abdomen is pretty much as in the Malayan *Elembra* Cam., but that has the antennæ placed in the middle of the face; the collar is shorter, and not keeled. It is not unlike *Taoga*, Cam., from Borneo; but that has the eyes pilose, the pronotum not keeled, the third abdominal segment nearly as long as the basal two united, and the antennæ shorter and thicker.

ARESSIDA CARINICOLLIS, sp.n.

♀. Green; middle of pronotum narrowly along central keel, central lobe of mesonotum, scutellum and parts bordering it dark purple; a large semicircular mark on first abdominal segment, commencing behind middle, and the others except for triangular green marks on the outer sides, the mark on the third larger than on the others, and the ventral surface except for green lateral marks, bordered with golden, of a brighter purple colour; pleuræ with brassy tints, propleuræ largely tinged with them; a small smooth, triangular mark under tegulæ, a longer one on apex, extending from top to bottom, and almost the upper half of metapleuræ smooth, fiery-red; as are also the greater part of the outer orbits, the malar space, and the apex of the clypeus. Antennæ black, tinged with dark purple, fifth and basal three-fourths of sixth joints white. Legs red, coxæ punctured, brassy-green like the body; hind tibiæ and apex of hind femora darker-coloured. Wings hyaline, nervures black, an oblique fuscous cloud running from end of costal nervure, and a larger triangular one running from the stigmal branch, becoming narrowed at the end, and uniting with the basal one, the hyaline space formed by their union being almost semicircular; an obscure, narrow smoky border on apex. Length, 12 mm.

Covered with a short white pile, very dense on sides of metanotum, less so on coxæ. Head and thorax closely punctured, very closely so on mesonotum and scutellum; pronotum nearly as long as wide at base, a distinct, smooth keel down the middle. Sheath of ovipositor projecting about one-half the length of the last segment, the latter forming a stylus.

BRACONIDÆ.

Braconinæ.

BRACON LEUCOSTIGMUS, sp.n.

♀. Red: antennæ, front, vertex, outer orbits to bottom of eyes, occiput, second and following segments of abdomen, and hind tibiæ and tarsi, black; wings fuscous-violaceous, stigma clear white; the greater part of first cubital cellule hyaline; third abscissa of radius a little longer than the basal two united; recurrent nervure received in the apex of first cubital cellule, clearly distinct from first transverse cubital nervure. Length, 5; terebra, 3 mm.

Face closely punctured, yellowish above middle, on the lower three-fourths raised into a conical area, the narrowed end above. Parapsidal furrows weakly indicated at base. Second abdominal segment without an area; the suturiform articulation narrow, smooth; there are no oblique furrows, but there are indistinct transverse ones on the apices of the third and fourth. Temples obliquely roundly narrowed. Palpi testaceous.

PLATYBRACON INSULARIS, sp.n.

♀. Luteous; antennæ and tips of mandibles black; head and thorax smooth, a band of fine striæ down middle of metanotum, the band becoming wider towards apex; basal four abdominal segments closely striated, the striæ stronger on the basal two segments; apices of third and fourth narrowly smooth; second with a straight oblique furrow running from base near middle to near apex, the space between the two at the base raised and striated, of equal width and bordered by a transversely striated furrow; furrows on third shorter, reaching to middle, wider and roundly curved. Wings blackish-fuscous, more or less hyaline at base of stigma, which is pallid ochraceous, narrowly black at apex; second cubital cellule about thrice longer than wide; third abscissa of radius as long as the basal two united; recurrent nervure received about the length of the basal abscissa of radius in first cubital cellule from each apex. Length, 10; terebra, 7 mm.

Basal segment of abdomen regularly, somewhat strongly striated, the raised central part roundly narrowed at base, its apex a little narrower than sides at apex. Sheaths of ovipositor stout, black, pilose, almost as long as metanotum and abdomen united.

NEDINOSCHIZA, gen. nov.

Head large, cubital, temples one-half longer than the top of eyes, rounded behind; occiput transverse, not margined. Apex of clypeus with a short, semicircular incision, the sides of which form teeth. Abdomen with only one transverse furrow, which is crenulated, and placed between second and third segments; there is a longish triangular area at base of second segment, bordered by an obliquely striated furrow; seventh segment almost one-fourth longer than sixth; hypopygium cultriform. Fore tarsi thrice longer than tibiæ, basal two joints united longer than them.

Malar space two-thirds of length of eyes. Antennal scape about twice and one-half longer than wide at apex. Radial cellule long, extending to apex of wing; radius issuing from near base of stigma. Second cubital cellule about thrice longer than wide, of equal width. Metathoracic spiracles large, about thrice longer than wide. Third and fourth joints of antennæ equal in length. Antennæ projecting from tubercles, which are more prominent on the outer side.

The mouth-opening is not quite as it is with the *Cyclostomi*, the open space being formed by the two projecting teeth, it being also much more shallow and smaller; the head is larger, more cubital than it is in *Bracon*, as well as wider, compared with the thorax. It differs from *Bracon* and *Iphiaulax* in the radius issuing nearer the base of the stigma. The fore tarsi, too, are longer, being nearly as long as the rest of the legs united.

MEDINOSCHIZA CRATOCEPHALA, sp.n.

♀. Black; head, pro- and mesothorax, and the four front legs rugose, head tinged with yellow; wings fuscous-violaceous, stigma and nervures black, the usual hyaline clouds at base of cubitus; smooth and shining, second cubital cellule thrice longer than wide. Length, 14; terebra, 14 mm.

Apex of first abdominal segment striated; there is a distinct triangular area, smooth, longer than it is wide at the base, with a keel which reaches to the apex of the segment, and bordered by a wide, obliquely striated furrow; the suturiform articulation is narrow and crenulated; from it runs a less distinct furrow; these are the only furrows.

Cheloninæ.

CHELONUS SALOMONIS, sp.n.

♀. Black; anterior tibiæ and the four front tarsi dark testaceous, covered closely with short white pile, longer on legs; wings hyaline to base of stigma, fuscous beyond, stigma and nervures black. Metanotum irregularly areolated. Keels stout, the central at the top of the apical slope ending in blunt tubercles; areola appendiculated at base, triangular, lateral areæ with some irregular striæ. Middle lobe of mesonotum with a double row of foveæ down the middle; apex with a longish central, and a shorter lateral area bordering it; sides of middle lobe finely punctured; lateral lobes reticulated, finely on the inner, coarsely and more distinctly on the outer. Pleuræ reticulated, metapleuræ more coarsely than meso- and the latter than the propleuræ. Basal third of abdomen rather strongly longitudinally striated, with some finer transverse striæ: the rest much more finely and closely, regularly striated, almost reticulated. On the sides of the vertex are some stout, oblique, clearly separated. Length, 5-6 mm.

Hormiini.

PEGARTHRUM FUSCIPENNIS, sp.n.

♂. Luteous; antennæ, mandibles, teeth, and apical joint of tarsi black; abdomen of a deeper, more rufous colour, middle segments infuscated; head and thorax smooth, metanotum keeled down middle, irregularly reticulated in centre, shagreened; basal four abdominal segments closely, finely, longitudinally striated, fifth weakly striated, apical smooth; basal three segments distinctly, fourth more weakly keeled down middle; a moderately wide, crenulated furrow at base of third and fourth segments. Pro- and mesopleuræ smooth, the latter slightly, finely, closely striated at base above middle; metapleuræ almost smooth in middle, top and bottom closely, mostly obliquely striated. Wings fuscous, base yellowish-hyaline to near transverse basal nervure, stigma and nervures black, parastigma pale ochraceous; second cubital cellule of equal width, about four times longer than wide; first transverse cubital nervure angled backwards above middle, and thickened; there is a cloud on either side of it, and one between apex of stigma and radius; recurrent nervure received in the apex of first cubital cellule, clearly separated from first transverse cubital nervure. Length, 15 mm.

Maxillary palpi coloured almost like the body, bare and shining; labial paler, and covered with white pubescence.

Comes near to *P. carinatum* Cam., from Batjian (Tijd. v. Ent., liii., 50); that is a smaller species (11 mm.), with hyaline wings, and with only the basal two abdominal segments keeled, the parastigma black. The maxillary palpi are longer than the head; they are thickened, and shaped as in the two known species.

Agathinæ.

AGATHIS FULGIDIPENNIS, sp.n.

♀. Luteous; antennæ, apex of hind tibiæ (about one-fourth of total length), apices of basal four joints of hind tarsi broadly, and the apical entirely, black; wings dark fuscous, tinged with violaceous, very iridescent; stigma and nervures black, parastigma fuscous; trophi testaceous, palpi covered with long pale hair; face, body, and legs densely covered with white pubescence. Basal areæ of metanotum stoutly transversely striated, areola narrowed into a triangle at base, where it is smooth, and without keels; beyond this are four stout, clearly separated, transverse keels; outer area more widely and more irregularly transversely striated; keel outside the spiracles roundly curved, and converging towards apex; three stout keels at base, and a stout curved one at base of apical fourth. Pro- and mesopleuræ almost impunctate, metapleuræ closely, rather strongly punctured. Malar space a little longer than eyes. Centre of face below tinged with rufous. Length, 8 mm.

First abscissa of radius a little shorter than second; second cubital cellule not much narrower in front than behind; second transverse cubital nervure thickened on the outerside in front. Antennæ densely covered with short, stiff, black pubescence.

EVANIIDÆ.

MEGISCHUS FROGGATTII, sp.n.

♀. Black; legs red; coxæ, trochanters, and the narrowed basal part of hind tibiæ black; femoral teeth about the same length, but the basal one much thicker at base than the apical, which is more slender, and of more uniform thickness; shortly beyond it are two short ones, basal a little longer and sharper than apical. A pale yellowish mark between the eyes and the base of the mandibles; basal joints of palpi reddish. Wings fuscous-violaceous, more deeply tinted in middle than at base or apex; stigma and nervures black. White ring near apex of sheaths of ovipositor as long as the black apical part. Length, 31; ovipositor, 33 mm. The two males in the collection are only 13-15 mm., in length.

Abdominal petiole as long as head and thorax united, and a little longer than the rest of abdomen; it is, as usual, closely, transversely, finely striated. Vertex from the hinder ocelli closely, strongly striated, the striæ more or less twisted; there is a smooth space below the ocelli, the sides of this bordered by longitudinal striæ; above the ocellus are five stout, widely separated striæ; the lower tubercle is broadly rounded at the apex, flat in the centre, with the sides raised; the other tubercles are oblique, sharply jointed. Pronotum smooth, the centre with a stoutly, transversely striated band; the smooth basal part has an oblique, stout tooth on either side of base. Base of mesonotum smooth, except for round, clearly separated punctures, the sides irregularly striated, the space between the striæ deep, distinct; the part bordering the scutellum bearing large, deep, scattered punctures;

scutellum at base bordered by a crenulated furrow, the scutellum itself being smooth. Metanotum with a crenulated furrow; the rest with the usual, round, clearly separated punctures. Propleuræ sparsely, widely punctured, the lower part aciculated; the lower, apical part of central depression and apex above with a few stout, deeply separated striæ. Mesopleuræ punctured, apical, upper half smooth; base strongly, closely punctured; the rest with the punctures smaller, and more clearly and regularly punctured. Third joint of antennæ a little shorter than fourth; the latter and fifth and sixth of almost equal length.

Comes near to *M. violaceipennis* Cam., from New Britain; it may be known, *inter alia*, by the black hind femora.

ICHNEUMONIDÆ.

Ichneumoninæ.

ERISTICUS SALOMONIS, sp.n.

♂. Black; head except occiput, and the greater part of upper third of outer orbits, pro- and mesosternum, lower third of mesopleuræ, metathorax, first abdominal segment, sides of second and third and their apices more narrowly, and legs, ferruginous-red; basal nineteen joints of antennæ red, turning into yellowish colour beyond middle; wings fuscous-violaceous, nervures and stigma black; areolet narrowed in front, nervures almost touching; recurrent nervure received distinctly beyond middle, discocubital and recurrent nervures with a distinct stump of a nervure. Areola about one-fourth longer than wide, basal nervure sharply angled inwardly, apex broadly rounded inwardly; post-petiolar area clearly separated, square, petiole smooth, post-petiole striated in the middle, sides in the middle distinctly punctured; second, third, and basal half of fourth segment closely punctured, striated in middle; gastracœli smooth, deep. Length, 15 mm.

Apart from the difference in colouration, the present species may be known from *E. froggattii* by the difference in the form of the areola: in *E. froggattii* it is almost twice longer than wide; in the species just described, horseshoe-shaped, about one-fourth longer than wide.

ERISTICUS FROGGATTII, sp.n.

♀. Black, shining; head, except conical spot over each antenna, stemmaticum, occiput, upper third of outer orbits, the black not touching the eyes, mandibular teeth, a small irregular spot near lower part of apex of mesopleuræ, a small narrow one at base of lower metapleural keel, a larger one surrounding metathoracic spiracles, abdominal petiole, except the post-petiole above, and apices of second and third abdominal segments narrowly, red; legs of a brighter red colour, the four front tibiæ and tarsi paler, more yellowish in tint. Basal six joint of antennæ rufous, seventh to eighteenth yellowish, the rest black. Palpi of a paler red colour than head; tips of mandibles black; wings fuscous, tinged with violaceous, nervures and stigma black, areolet 5-angled, the nervures almost touching in front; recurrent nervure received shortly beyond middle; transverse median shortly beyond transverse basal; disco-cubital and recurrent nervure with a distinct stump of a nervure. Head smooth; face, except in the slightly raised centre, closely, weakly punctured; clypeus more strongly and sparsely punctured, its sides rounded at apex. Mesonotum and scutellum almost smooth; base of metanotum smooth, the rest closely but not strongly punctured; areola open at the top, about twice longer than wide, slightly roundly narrowed from the transverse keels. Propleuræ smooth, lower part with curved striæ; upper two-thirds of mesopleuræ smooth, lower part and sternum closely punctured; apex with a crenulated border; metapleural spiracular area closely punctured, almost reticulated behind spiracles; the rest closely, strongly, obliquely striated. Post-petiole closely striated in centre, the rest distinctly punctured; second, third, and basal half of fourth segment closely punctured, the following segments smooth, the last with basal half white. Gastracœli deep, smooth, striated in centre of basal part. Tarsi closely spinose below. Length, 17 mm.

The male is smaller, has the antennæ serrate, and the abdominal petiole entirely red; the post-petiole is almost entirely smooth; the red on the basal joints of the antennæ only extends to the fourth.

Cryptinæ.

MESOSTENUS INSULARIS, sp.n.

Black; legs bright red, a broad white band near centre of antennæ, palpi pale testaceous; apex of labrum bordered with testaceous: wings hyaline, stigma and nervures black; areolet small, twice longer along radius and cubitus than along transverse nervures, of equal width; recurrent nervure received near apex; transverse median nervure received shortly beyond transverse basal. Face closely, distinctly punctured, more strongly in middle than on sides; clypeus almost smooth. Front raised in middle, sides deeply depressed; a decurrent keel from the ocelli. Mesonotum finely, closely punctured: smooth on outer half of lateral lobes. Scutellum smooth and shining. Metanotum at base closely punctured, more or less reticulated; middle part closely, irregularly, longitudinally striated, apical slope more strongly transversely striated. Metapleuræ strongly, irregularly striated, more strongly above furrow than below it. Propleuræ finely punctured, finely, obliquely striated in middle. Mesopleuræ distinctly striated, except at apex above. Abdomen smooth and shining. Metanotal teeth minute, but distinct enough. Transverse median nervure in hind wings broken near the bottom. Thorax fully thrice as long as wide. Parapsidal furrows reaching to base of apical fourth. Post-petiole not abruptly thickened; spiracles slightly more removed from each other than from apex. Head wider than thorax.

Ophioninæ.

ENISCOSPILUS SALOMONIS, sp.n.

♀. Luteous; outer orbits pallid yellow, apical abdominal segments darker in colour, ocellar region pallid yellow, hinder ocelli almost touching eyes; the three are separated by almost the same distance from each other. Wings clear hyaline; costa, stigma and nervures black, basal abscissa testaceous; there are two horny points, one, near base of radius, roundly narrowed in front, rounded as at apex; the other near apex, transverse, conical, half the size of basal; transverse cubital nervure roundly curved, half the length of the space between it and the recurrent nervure, which is about one-fourth shorter than the latter. Metanotum densely covered with white pubescence; the part behind keel aciculated; the rest irregularly, mostly longitudinally striated, striæ stout and twisted, and much stronger in middle. Propleuræ almost smooth; mesopleuræ closely, finely, distinctly punctured, more weakly above middle than below; metapleuræ more strongly punctured; lower part of spiracular area irregularly, obliquely striated in middle below, striæ more or less twisted. Scutellum keeled to near apex. Temples small, obliquely, roundly narrowed. Length, 18 mm.

Basal abscissa of radius clearly thickened, and shorter than second; clear space in the discoidal cellule commencing behind the basal horny point. Antennæ with the apical half infuscated.

I am not sure but that this species may be the same as *E. expeditus*, Kohl., from Samoa (Bat. u. Zool. Ergebnisse von den Samoa u Salomonsinseln, 10, pl. iii., f.5,.

Pimplinæ.

ECHTHROMORPHA PALLIDILINEATA, sp.n.

♀. Rufous; face, clypeus, labrum, malar space, orbits, tubercles and narrow lines on apices of abdominal segments, narrowed in middle, pallid yellow; legs coloured like body, base of anterior pair paler, more yellowish in tint; antennæ pallid red, deeper in colour at base; wings highly iridescent, brassy coloured at base, apex not very deeply clouded, stigma dark fuscous, nervures black; areolet not appendiculated, but the nervures united in front; recurrent nervure received in middle. Length, 13-14; terebra, 3-4 mm.

Head smooth, thorax closely punctured: propleuræ, upper half of mesopleuræ at base and, to a less extent, at apex above, and middle of metanotum broadly, smooth. Abdomen sparsely, weakly punctured; lower edge of sides of first segment with a broadly rounded furrow. Apical third of discocubital nervure roundly curved towards cubitus.

A distinct species, easily known by the uniformly rufous body, the absence of lines on the mesonotum, and the brassy-tinted wings. Its scutellum is more roundly convex, more raised over the mesonotum, than it is in *E. notulatoria*, F. Sec. Krieger, being more like that of *E. insidiator* and *E. rufa*, Cam.

ERYTHROPIMPLA PALLIDICEPS, sp.n.

♀. Black; head pallid yellow, as are also the mandibles, except at apex; palpi, thorax, the four front legs, except apex of middle coxæ, middle trochanters, and antennal scape, red; wings uniformly fuscous-violaceous, nervures black; areolet longish-triangular, moderately large, shortly appendiculated, receiving recurrent nervure in the apex, bullated at cubitus, recurrent nervure with two bullæ. Length, 17; terebra, 16 mm.

Sparsely covered with pale pubescence the metathorax densely so Prothorax paler coloured than the rest of thorax, metathorax more deeply tinted than mesothorax. First abdominal segment with a keel on either side of middle, the keels stronger at base, not reaching to apex; basal two-thirds of the space between them smooth and shining, the apical closely, not very strongly punctured, and with a narrow keel down the middle; basal five segments closely, distinctly punctured, with the usual transverse furrows, more weakly punctured; sixth segment as closely, but more finely punctured, without a transverse furrow; seventh shining, impunctate. There is a short, smooth furrow at the base of the metanotum in the centre; the rest of the metanotum closely, distinctly punctured. Basal three segments of abdomen united, longer than thorax. Ovipositor as long as abdomen; sheaths moderately broad, densely pilose.

Has the body- and leg-colouration of *E. ariana* Cam., from Assam; but that has the wings yellowish-hyaline, clouded at the apex. *E. flaviceps*, Cam., from New Guinea, is almost similar as regards colouration, but has the head more distinctly yellowish in tint, the metathorax fuscous, and the asal segment of the abdomen; and the central part of the segment is not clearly raised and separated, while its sides are not keeled.

Obs.—Erythromorpha Ashm., is very closely allied to *Trichiothecus* Cam., from Assam; it may be known from the latter by the clypeus being deeply, roundly incised; while, in *Trichiothecus*, it is only depressed at the apex and transverse; the sheaths of the ovipositor are broader, and more densely pilose, the hairs, too, being longer. The colouration of the two is very similar, black, with the fore legs, head, and thorax red, the wings uniformly fuscous. In *Trichiothecus* he disco-cubital nervure is broken by a minute stump of a ure.

LISSOPIMPLA RUFIPES, sp.n.

ack; antennal scape and sides of face bordering the
rea, red; labrum at apical half of a more obscure
blique line on either side of front, commencing near
elli and obliquely narrowed below where they touch
a small transverse mark on either side of base of
e of mesonotum, a wider one of about the same
ex, tegulæ, and two almost united spots
ind coxæ. Legs red; four anterior tarsi,
d tarsi, black; tibiæ in middle broadly

tinged with red. Wings clear hyaline, stigma fuscous, nervures black, areolet oblique, nervures uniting in front; recurrent nervure received at apex of areolet, interstitial with second transverse cubital; transverse median behind transverse basal. Length, 9; terebra, 4 mm.

The outer margins of the central part of the face are roundly curved outwardly, the middle is finely keeled. The furrows of the mesonotum are united into one at the base of the apical third; they are smooth. Lower third of propleuræ finely, obliquely striated; apex of mesopleuræ crenulated. The middle of the metanotum is slightly raised, forming almost an area of equal width, shining, almost smooth the rest is somewhat strongly and closely transversely striated, at the base the striæ being finer and more oblique. Metapleuræ irregularly shagreened. Abdomen smooth and shining; first segment nearly as long as the following two united. Mesosternum reddish. Tooth on hind femora small but distinct, oblique. Palpi pallid testaceous.

The affinities of this species are with *L. rufipes* Cam., from Ceylon, rather than with any known Australian species; it is more slenderly built, especially as regards the abdomen, which wants the coloured bands of *L. rufipes;* and the scutellum, metanotum, and pleuræ the white spots. In my figure of *L. rufipes* (Spolia Zeylanica, iii., p.140, Pl. B), th transverse median nervure in the hind wings is shown br too low down; it is a characteristic of *Lissopimpla* th broken near the top.

XANTHOCRYPTUS LUTEUS, sp.n.

♀. Ferruginous; head and antennæ tinged witl the eight or nine apical joints of antennæ black, as i apex of mandibles; wings hyaline, tinged with ful with a smoky border, costa and stigma testaceou black; base of metanotum in centre finely, ir tudinally striated; the rest, from the strongly, and more widely transversely s.

closely, obliquely striated, striæ closer at base. Base of mesopleuræ striated, the striæ more or less curved, and running from top to bottom; the centre weakly punctured, apex from near the top striated, striæ at the base stronger, more oblique and wider apart than they are at apex. Mesonotum finely, not very closely, punctured; apex of middle lobe longitudinally striated. Length, 12; terebra, 5 mm.

A few points of generic importance may be drawn from this species, supplemental to those given in my description of the genus in the Proceedings of the Zoological Society (1901, 233). The mandibles apparently do not meet in front; their two teeth are short, equal in length, bluntly rounded, and separated behind by a furrow. Occiput roundly incised, margined. The smooth basal part of the metanotum is bounded by a roundly curved keel, which, at the sides, extends to the base of the metanotum, inclosing the spiracles, which are oval, and twice longer than wide. Antennæ slender, 27-jointed, the basal joints of flagellum elongated, the first a little longer than second. The fifth and sixth abdominal segments united are as long as the fourth; the sixth is the smallest, about one-half the length of fifth; the penultimate is as long as the second, and one-fourth longer than the last, which bears long cerci. Legs long and slender; claws simple, small; hind coxæ as long as first abdominal segment. The disco-cubital nervure is broadly, roundly curved.

Xanthocryptus belongs to the *Xorides* rather than to the *Cryptinæ*, but it is not quite typical in some respects. In Ashmead's arrangement of the *Xorides* (Bull.U.S.Nat.Mus., xxiii., 61) it runs near to *Perosis*, with which it cannot be confounded.

FURTHER NOTES ON SOME RARE AUSTRALIAN *CORDULIINÆ*, WITH DESCRIPTIONS OF NEW SPECIES.

By R. J. Tillyard, M.A., F.E.S.

(Plate x.)

The following species are dealt with in this paper :—

1. *Hemicordulia intermedia* Selys.
2. „ *continentalis* Martin.
3. „ *superba*, n.sp.
4. *Procordulia jacksoniensis* Rambur.
5. *Hesperocordulia berthoudi*, nov.gen. et sp.
6. *Lathrocordulia metallica*, nov.gen. et sp.
7. *Macromia viridescens*, n.sp.

The remarkable character and extent of the Australian *Corduliinæ* is becoming more and more emphasised. Including the four new species described in this paper, and a new species of *Cordulephya*, which I propose to deal with in a separate paper on that genus (to be published shortly), the total number of Australian *Corduliinæ* so far known is 34, out of a total of about 150 species described for the whole world; that is, two-ninths of the whole! Out of a total of 36 genera, no less than 14 are represented in Australia; and of these, twelve are peculiarly Australian or Australasian.

1. Hemicordulia intermedia Selys.

Besides the type-male in Hagen's Collection, only two other specimens of this rare insect were known. These were two males of rather small size, taken by me at Cooktown in January, 1908.* It was with great surprise and pleasure, therefore, that I rediscovered this species on the Horton River, at Pallal, near Bingara, N.S.W. Though it was by no means common, I secured a very fair series of seventeen males and four females, mostly in excellent condition. These are of larger size than the Cooktown specimens, and agree very closely with Hagen's type, which probably came from Southern or Central Queensland. As I have already figured and discussed the male in my former paper, it is only necessary here to give the measurements of the Pallal series, and to describe the hitherto unknown female.

♂. Total length, 44-46; abdomen, 32-34; hindwing, 29-31 mm.

Differs from the figure of the Cooktown male† in possessing a broader, more *corduliform* abdomen; otherwise the form and markings correspond exactly.

♀. Total length, 48; abdomen, 35; hindwing, 31 mm.

Wings: *neuration* blackish, except costa, subcosta and antenodals, pale brownish. A tinge of saffroning at bases, especially near membranule of hindwing. *Pterostigma* 2 mm., very dark brown. Head and thorax as in male, but with somewhat duller colouration, the yellow on the front being replaced by glaucous-grey, and the T-mark being less distinct; also the black thoracic bands not quite so wide. Abdomen: 1, 2, and half of 3 much swollen, the rest nearly cylindrical but tapering slightly to 10. Colouring as in male, but with the black markings of 2 and 3 much larger and broader; 9, quite black; 10, very short, basal half black, apical half clear yellow. *Vulvar lamina*: end of 8 with two small yellow rounded projections; 9 rather hollow, with the central ridge projecting apically, pale brownish. Appendages: 1·6 mm., black, hairy, narrow sublanceolate, wide apart, separated by a hairy rounded tubercle on 10, which carries a double yellow spot above.

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* See these Proceedings, 1908, xxxiii., p.740, Pl.xxi., figs 2-4.

† *Loc. cit.* Pl.xxi., fig.2.

Hab.—Pallal, N.S.W.; in December, 1910. It is confined to the main Horton River, and only occasionally appears on the smaller creeks.

Types: ♂, in Coll. Hagen (Queensland); ♀, in my collection.

2. Hemicordulia continentalis Martin.

Four males and three females of this rare species were taken by Mr. H. Elgner at Darnley Island, Torres Strait, in December, 1909. Mr. F. P. Dodd has also taken a single male, immature, at Port Darwin (undated). These are now in my collection. They all resemble very closely the small-sized male taken by myself at Kuranda, N. Queensland, in January, 1905.† M. René Martin's types, taken in New South Wales and Queensland, are larger. This species, like the preceding, clearly attains its greatest development in Central-East Australia, the tropical representatives being somewhat dwarfed.

3. Hemicordulia superba, n.sp. (Plate x., figs.5-8).

♂. Total length, 54; abdomen, 40·5; hindwing, 33 mm.

Wings: *costa* pale yellowish outwards to nodus, rest of neuration black; *pterostigma* 1·6 mm., black; *membranule* narrow, forewing 1·5, hindwing 2·3 mm., grey-brown touched with white at bases; subtriangle of forewing generally 3-celled, but sometimes 2-celled on one or both sides. *Nodal Indicator* $\left\|\begin{matrix}7\text{-}8, & 5\\ 5, & 6\text{-}7\end{matrix}\right|$

Head: *eyes* dark greenish (brown in dead insect); *vertex* tubercled, small, yellow above, dark steel-colour on sides; *antennæ* black, 2·5 mm., *front* somewhat indented medially, black with steely or greenish metallic reflections, two very conspicuous round yellow spots above, wide apart; lower part of *front*, *clypeus*, *labrum* and *labium* bright yellow, two small dull black dots in upper labral suture, and a distinct bright black dot in middle of base of labrum. Thorax: *prothorax* small, metallic steely black, with a dorsal yellow spot and broad yellow basal collar. *Meso-* and *metathorax* black, with metallic steely or greenish reflections above, a short yellow line on dorsal ridge, and two rather irregular yellow antehumeral bands, pointed forwards and broadening inwards basally near interalar ridge; this inner extension being slightly clouded with grey. Sides bright lemon-yellow, with two very irregular metallic black bands in sutures. *Notum* downy, wing-bases broadly black with a conspicuous yellow spot on hind wing-bases, scuta and scutella yellow. *Legs* long, black, except coxæ, which are yellow, also foretrochanters, part of underside of profemora, and part of midtrochanters yellow; *tibial keel* of forelegs 2·5 mm. long. Abdomen: 1-2 enlarged, 3 pinched, 4-7 rather broad, 8-10 narrower. Colour: 1, bright lemon-yellow; 2, steely black, with a central transverse yellow band just broken dorsally; 3-10 black, with steely and greenish metallic reflections, marked with bright lemon-yellow as follows—3, on each side a long stripe crossed at the middle by a black line on the supplementary carina; 4, two large basal marks reaching to supplementary carina, 2 mm. long, and isolating a narrow irregular dorsal band; 5, two smaller basal spots nearly meeting dorsally, also two tiny central flecks; 6 similar to 5, basal spots somewhat narrower, central flecks reduced to points (sometimes absent); 7, basal half yellow, with a fine black dorsal line, the *junction of the black and yellow very irregular*; 8, a small basal spot low down on each side; 9, black; 10, basal suture yellowish, a conspicuous apical yellow spot. Appendages: *superior* long, 3·7 mm., with many small hairs, black, very wavy; basal fourth slender, with a sharp and conspicuous inner inferior spine; second quarter widening and curving outwards; third quarter still wide, curving inwards; apical quarter tapering to tips, which are fairly pointed. Seen in profile, the second half is much depressed below level of first half. *Inferior* short, scarcely 2 mm., black, narrow-triangular, hairy beneath, concave above. (Plate x., figs.5-6).

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† *Loc. cit.* p.742.

♀. Total length, 51; abdomen, 39; hindwing, 34 mm. Similar to male, but with shorter and more cylindrical abdomen; 1-2 somewhat enlarged (in profile, 1, 2 and half of 3 much swollen), 3-6 quite cylindrical, 7-10 tapering slightly. Colour: 1, yellow; 2, yellow, with a rectilinear basal black patch and large triangular apical black patch spreading irregularly down over the sides; 3, as in ♂, but with dorsal black area much wider; 4-10 as in ♂. *Vulvar lamina*: 8 ending in two small rounded processes, bright yellow edged with black; base of 9 with two small double tubercles, semi-transparent, very pale, rest of 9 with a rather blunt central black ridge projecting apically (Plate x., figs.7-8) Appendages 2 mm., black, downy, narrow-lanceolate, with a rounded hairy tubercular projection of 10 lying below and between them.

In the female, the wings are often tinged with yellowish-brown on the apical half, between nodus and pterostigma; this disappears in very mature females.

Hab.—Pallal, N.S.W.; in December, 1910. Nine males and six females in good condition, taken by myself.

Types: ♂♀ in my collection

Along the coast of Australia, from South to West Australia, through to Adelaide and Melbourne, and up to north of Sydney, the two representatives of the genus *Hemicordulia* are *H. tau* and *H. australiæ.* The former is found everywhere, even on the smallest waterhole, but the latter is confined to the rivers. My visit to Pallal enabled me to obtain some idea of the distribution of species west of the main ranges. I find that *H. tau* is by no means common, and usually occurs on stagnant ponds and water-holes, station-dams, etc., where it has evidently followed settlement into the interior. On the main rivers it is very rare, but occurs occasionally. I am inclined, therefore, to regard *H. superba* and *H. intermedia* as the western representatives of the genus. Of these two, there is no doubt that the latter fills exactly the place occupied by *H. australiæ* along the coast. In flight and habits these two species are very similar, though in colouration *H. intermedia* inclines rather to *H. tau* than to *H. australiæ.* *H. superba* has, as far as I know, no coastal representative. In colouration it is almost exactly like *Synthemis regina*, the largest and most beautiful of the *Synthemina.* These two species were flying together high up in the clearings along Tea-Tree Creek, near Pallal. It was quite impossible to tell at sight which species was which, for *H. superba* imitates the flight of *S. regina*, soaring slowly and calmly to and fro. If struck at, however, the difference in flight-power is at once evident—*H. superba* immediately making off at immense speed, while *S. regina* is usually only slightly disturbed, and returns again to its old haunt, being thus easily captured. On the Horton River at Pallal, a broad flowing stream, *S. regina* does not occur, but the males of *H. superba* patrolled the banks, generally keeping just out of reach of the net. Here they flew swiftly, stopping frequently at some fancied spot, and remaining poised and stationary, with eyes gleaming and all their brilliant colouring well displayed. The only way to catch them was to note where they turned into some small bay or inlet to capture gnats, and then to hide behind some bush ready to strike at the insect on his next visit. Failure at the first stroke sent the insect far away, probably to take up some other "beat" on the river.

These insects appear to be rather fiercely disposed towards the dragonflies on the river. Generally three or four *H. intermedia* would "patrol" past before an *H. superba* came in sight, and the former kept closer in shore and were easier to capture. The larger insect, however, would often dart in and attack the smaller, driving it away just as I was about to strike. This was done with such rapidity that it was almost impossible to follow what took place.

This fine insect is easily the most distinct and beautiful member of the genus. It is probably most closely related to *H. intermedia*, but can be at once distinguished from that species by its much greater size, more brilliant colouration, by the peculiar pattern of the front (which may be considered as the intermediate stage between the T-mark and the bright metallic crest), also by the very long appendages of the male. The actual colour-pattern of the abdomen is very similar to that of *H. intermedia*, but whereas in the latter the join of the black and yellow on segment 7 is *quite straight*, in *H. superba* it is *very irregular*. The very distinct antehumeral yellow bands of the thorax distinguish it at once from all other members of the genus, and the beautiful colour-pattern of the sides of the thorax is also unique.

Omitting *H. novæ-hollandiæ* Selys, for the present, from the following table, since nothing certain can be gathered about this species (unless, indeed, as seems very probable, *H. continentalis*

Martin, is synonymous with it), we can now classify the Australian members of the genus *Hemicordulia* as follows :—

	Front *with* a distinct black T-mark above	1.
	Front *without* a distinct black T-mark above	2.
1.	Segment 7 with basal half yellow, *cut straight off* across middle of segment. (Appendages of ♂ with a sharp spine)	*H. intermedia.*
	Segment 7 metallic greenish-black, with orange low down on sides. (Appendages of ♂ with upturned tips, no spine)	*H. tau.*
2.	Front with two distinct round yellow spots above	*H. superba.*
	Front brilliant metallic greenish above	3.
3.	Appendages of male *with* a sharp spine	*H. australiæ.*
	Appendages of male without any spine	*H. continentalis*

Note.—It is difficult to separate the females of *H australiæ* and *H. continentalis*, but the latter is generally *smaller*, has a *shorter* pterostigma, and slightly *longer* appendages than the former.

4. PROCORDULIA JACKSONIENSIS Rambur.

This insect was, until lately, exceedingly rare in collections. In the de Selys Collection there are Rambur's four types, from New South Wales; and a specimen in Hagen's Collection is said to come from Western Australia, though this is very doubtful. I took a single female at Gisborne, Vic., in December, 1908; and was agreeably surprised to find it, in swarms, on the lagoons near Cressy, Tasmania, in January, 1909. There I took about eighty magnificent specimens, and also found the larva. The following is a description of the Cressy series:—

♂. Total length, 44-45; abdomen, 32-33; hindwing, 28-29 mm.

Wings: *bases* just touched with black and saffron; *pterostigma* brown, 2 mm.; *membranule* 4·5 mm., dark brown tipped with white. *Nodal Indicator* $\left\|\begin{matrix}7\text{-}8 & 6\\ 5 & 6\text{-}7\end{matrix}\right|$ Head: *eyes* dark brown, with soft grey hairs behind; *vertex* small, brown; *front* wide, somewhat depressed medially, brilliant metallic green above, yellow on sides, glaucous-brownish shading to livid-grey on face; *clypeus* and *labrum* glaucous-greyish; *labium* pale dirty straw-colour. Thorax: *prothorax* pale brown above, dark brown on sides. *Meso-* and *metathorax* very hairy, burnished bronze-green, touched with brown on shoulders; *underside* brown, *notum* brown, wing-bases hairy, scuta and scutella pale straw-colour. *Legs* black, profemora and underside of metafemora brown. Abdomen: 1-2 enlarged, 3 somewhat pinched; rest of abdomen considerably dilated, 4-7 very wide, 8-10 tapering rapidly. Colour: 1-2 dark brown, each with a conspicuous transverse apical band of cream-colour; 3-10 dark metallic greenish-black above, sides rich orange except near sutures, the orange patches being only *slightly* widest near middle of each segment; 3-9 with a narrow, transverse, apical band of cream-colour; 10, apical half orange, with a small spine on each side. Appendages: *superior* 2 mm., narrow curved sublanceolate, approaching each other so as nearly to touch at two-thirds of their length, the apical one-thirds strongly divergent and somewhat depressed, tips rounded; colour black, with a few small hairs. *Inferior* 1·5 mm., subtriangular, tip slightly upcurved; pale brown bordered with black.

♀. Differs from male as follows: metallic colour of front much duller, sometimes brownish, thorax less metallic. Abdomen broad, almost cylindrical, the orange and metallic colouration duller; 10 with basal third black, the rest orange. *Vulvar lamina* with two short subtriangular projections from end of segment 8. Appendages 2·3 mm., rather thick, hairy, dark brown, outer edge straight, inner edge distinctly curved, tips slightly pointed.

Hab.—Tasmania: abundant on the lagoon near Cressy, also fairly common on the Macquarie River (January, 1909). Victoria: Gisborne, 1 ♀ (December, 1908).

Types: ♂♀. Coll. Selys (four specimens from N. S. Wales). The fine series from Cressy has been distributed by me, as far as possible, amongst all the modern collections; my own series contains 22 males and 13 females.

An interesting fact concerning this insect is that it is undoubtedly being rapidly exterminated from the Tasmanian rivers by the introduced English trout. I am quite certain that it scarcely ever breeds in the rivers now, and that the specimens that fly on the Macquarie River are the overflow of the abundant swarm from the lagoons. On the fine North and South Esk

Rivers not a specimen can be seen; indeed the Odonate fauna of these streams, and of the beautiful Derwent River in the south, is almost completely annihilated. The following analysis of the contents of the stomach of a fine trout (about 3 lbs.) taken by me in the Macquarie River may be of interest—a portion of a single beetle, and *thirty-seven* undigested dragonfly heads, of which *no less than thirty-two* were recognisable as those of *Procordulia jacksoniensis*, the other five being apparently *Austrogomphus guérini*. While trout-fishing, I carefully observed this species, and noticed that it is very fond of skimming the surface of the water, like a *Libelluline*. This is a fatal habit, for I saw, several times, a trout seize the insect while in rapid flight close to the water. I also noticed that it often *dips itself* in the water, and then rises and hovers for a short while. On one such occasion, a kingfisher dashed down and seized the insect.

One might venture the prediction that, in a very few years' time, this insect will be confined to the lagoons, and that it will become a dull-coloured uninteresting-looking species of more robust build than at present, the supply of food on the lagoons being more abundant. Compared with its congener, *P. affinis* Selys, of Western Australia, which is only found on the running brooks, it is already of a thick-set and more robust habit, and of a much duller colour on the abdomen.

I am of opinion that the two species, *P. jacksoniensis* and *P. affinis*, are truly geminate species, portions of an original single stock which became separated by the great Desert Barrier. *P. affinis* has followed the line of development of *Hemicordulia australiæ*, which species it exactly resembles in flight and colouration; while *P. jacksoniensis*, though still retaining the metallic front, is following the line of development of *H. tau*.

The three genera, *Somatochlora*, *Procordulia*, and *Hemicordulia*, are of great interest to students of zoogeographical distribution. *Somatochlora* is evidently the most archaic, and is one of the few genera of known bipolar distribution. In the subarctic regions of Canada and Siberia, it has attained its greatest development. But alongside that development, we find it represented in the subantarctic regions of New Zealand and Chili, by a small remnant at the present day, consisting of only three species (*S. grayi* Selys, *S. braueri* Selys, and *S. villosa* Rambur; the first two from New Zealand, the last from Chili). The main body of the southern *Somatochlora*-stock may have included a large number of species at a period when our southern land-areas were much larger than they are now. Before and during Miocene times, these were becoming faced with a harder struggle for existence, mainly due to the shrinkage of their territory; so that a remnant gradually fought their way northwards to the warmer temperate and even to tropical regions. As this proceeded, they became modified, firstly to the intermediate *Procordulia*-type, and finally to the *Hemicordulia*-type, which, in its rounded hindwing in both sexes, shows a cænogenetic convergence to the *Libellulinæ*.

The most archaic forms are evidently those northern species of *Somatochlora* whose females still retain a remarkably enlarged terebra. Our three southern species show a definite advance in the reduction of the vulvar lamina to the more usual *Libellulid* proportions. The gradual rounding of the anal angle of the hindwing of the male is clearly seen in comparing the three genera, *Procordulia* showing a "half-way" stage, between *Somatochlora* and *Hemicordulia*. Also the second cubital cross-vein of *Somatochlora* is eliminated in the two latter genera.

HESPEROCORDULIA, nov.gen. (Plate x., fig.1).

Head and thorax robust. Legs *long and slender*. Abdomen slender, *cylindrical*. Triangles of all wings and subtriangle of forewings free. Sectors of arculus separated at bases. Arculus placed between first and second antenodals, but nearer to former than to latter. Triangle of hindwing *almost completely recessed* to level of arculus. *Only one* cubital cross-vein in hindwing, and hence no hindwing-"subtriangle." Post-trigonal space of forewing *beginning with one row of cells*, but sooner or later giving place to two (variable). Anal loop long and narrow, fairly well defined, apical end not enlarged, but cut straight off by a transverse vein; longitudinal bisector fairly well defined. A small cross-vein low down in anal triangle of hindwing.

Type: *Hesperocordulia berthoudi*, n.sp.

This genus is intermediate between the two main divisions of the *Cordulina* (s.str.), of which the typical genera may be taken to be *Somatochlora* and *Syncordulia*. To the former, it is related by its robust build (large head and thorax), long slender legs, and open venation; also by the practically complete recession of the hindwing-triangle to the arculus, and by the long anal loop, showing a longitudinal bisector. With the latter, it agrees in its slender noncorduliform abdomen, and in its uncrossed triangles and forewing-"subtriangle." Of Old World genera, it probably comes closest to *Oxygastra*, which it resembles closely in the form of its anal loop, triangles and forewing-"subtriangle"; it differs, however, from this genus in not possessing the second cubital cross-vein in the hindwing, and in the *almost complete* recession of the hindwing-triangle.

In colouration, it is quite unlike any known *Corduline*, being bright red and black. This colour and the regular pattern of the abdomen, together with the thoracic colour-scheme and the shape of the head, thorax, legs and abdomen, irresistibly suggest a far closer relationship between this genus and *Cordulephya* than a comparison of the wing-venations would indicate.

5. Hesperocordulia berthoudi, n.sp. (Plate x., figs. 1, 3, and 9).

♂. Total length, 54; abdomen, 41; hindwing, 30·5 mm.

Wings: a small patch of orange at nodus, also at base of wings (this colouring disappearing when the insect becomes fully matured). *Pterostigma* 2 mm., orange. *Membranule* narrow, whitish, fore 2, hind 4 mm. *Nodal Indicator* $\left\|\begin{array}{cc}7 & 5\\ 5 & 7\end{array}\right|$ Head: *eyes* dark reddish-brown; *vertex* blackish; *front* deeply cleft medially, yellowish-brown, shiny; *clypeus* shiny-brownish; *labrum* reddish-brown; *labium* orange. Thorax: *prothorax* small, brownish. *Meso-* and *metathorax* rich orange-brown, with very long grey hairs; marked with bright metallic greenish as follows—basal portion of dorsum on each side of dorsal ridge carrying a large irregular patch, subrectangular, with its upper part cut out rectangularly; on each side a large spot near mesocoxa, also a broad sublateral band; *notum* orange-brown; *legs* long, black. Abdomen slender, 1-2 somewhat enlarged. 3 narrower, 4-6 narrow, 7-10 slightly enlarged. *Colour*: 1, metallic black; 2, rich orange-red, with very small auricles, a broad transverse apical band of black; 3-7 bright orange-red, marked with metallic black as follows—3, an apical transverse black band projecting in a black line along dorsum to middle of segment; 4-7, apical half black; 8, black, with two large basal orange-red spots reaching nearly to middle of segment; 9-10, brownish on dorsum, sides irregularly marked with black. Appendages: *superior* very long, slender, 4·8 mm., slightly wavy, diverging a little at base, then slightly converging; tips roundish; inner margin very hairy, showing, when viewed sideways, a very small obtuse projecting spine one-third from base; colour blackish. *Inferior* 2 mm., elongate subspatulate, tip rather truncated, slightly upcurved; colour semitransparent orange, with darker tip (Plate x., figs 3, 9).

♀. Total length, 48; abdomen, 36; hindwing, 31·5 mm. It differs from the male as follows. Wings: *pterostigma* 2·5 mm., orange; *costa* of all four wings washed with orange, especially at base, nodus, and pterostigma (this colouring most intense in the young female, persisting in the mature female, and only disappearing in very matured specimens). Head: *front, clypeus*, and *labrum* orange. Thorax as in ♂. Abdomen: broader and shorter than in ♂; colour orange-red, slightly duller than in ♂; 1, blackish; 2-7 with apical black bands, narrow on 2, then broadening gradually until they are nearly half as broad as the whole segment on 6 and 7; 5-7 with the black running up along the dorsum in a sharp spike; 8, as in ♂, but duller; 9, orange, with two small apical black spots; 10, very short, orange. Vulvar lamina very short, slightly bifid, rounded, black; two small point-tubercles on 9. Appendages 1·3 mm., wide apart, narrow, straight, pointed, brownish, separated by a large bifid tubercle on 10.

Hab.—Waroona. W.A.; November-December, 1909 and 1910. Taken by my friend, Mr. G. F. Berthoud, to whom I dedicate this species.

Concerning this very remarkable dragonfly, Mr. Berthoud writes to me as follows. "The captures range from October (end) until towards end of December. I never saw a single one in the new year. I do not know if they die out or go elsewhere, but they cannot be found about here in January. They frequent thick 'blackboy' and palm-scrub close to the brook, but I never saw them hawking about on the water. They sit on the leaf of a 'blackboy' or palm, flying off at the least alarm, usually upwards over the scrub, and alight again a chain or two away on another leaf. If one can see or note the spot, they may be captured fairly easily. On the wing, they are very active and mostly high out of reach. I once saw a pair *in cop.*, but failed to get them. Although fairly numerous, they are not easily caught, and it takes a lot of careful hunting to get a few. On some very good days I have taken four, but mostly only one or two. The fine, highly-coloured males are especially smart, keeping well out of my reach."

Types: ♂♀., and series of cotypes, in my collection.

LATHROCORDULIA, nov. gen. (Plate x., fig.2).

Head and thorax robust. Legs *short*. Abdomen slender, cylindrical. Triangles of all wings and subtriangle of forewings free. Sectors of arculus separated at bases. Arculus placed about midway between first and second antenodals. Triangle of hindwing *nearly* recessed to level of arculus. Second cubital cross-vein of hindwing present, forming a small "subtriangle." Post-trigonal space of forewings with one row of cells up to near tip of wing. Anal loop rather short, only moderately well defined, with no straight apical boundary, and no defined longitudinal bisector. A small cross-vein low down in anal triangle of hindwings.

Type: *Lathrocordulia metallica*, n.sp.

Allied to *Syncordulia*,* from which it can be at once separated by its more robust build (especially its large head and thorax), its more open venation and smaller number of ante- and postnodals, the greater amount of recession of its hindwing-triangle, and its more poorly developed anal loop. Also closely allied to

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*It must be understood that I refer here to *S. atrifrons* McLach., which I assume is congeneric with the type *S. gracilis* Burm., of which no really reliable or sufficiently full descriptions are available.

Gomphomacromia (*G. paradoxa* Brauer), which it resembles in the shape of its triangles, and the presence of the second cubital cross-vein in hindwing. The form of the anal loop is intermediate between those of *Syncordulia* and *Gomphomacromia.*

6. LATHROCORDULIA METALLICA, n.sp. (Plate x., figs.2, 4, and 10).

♂. Total length, 54; abdomen, 42; hindwing, 31 mm.

Wings: *neuration* black, open; with about 1 mm. of dark saffroning at wing-bases. *Pterostigma* 3 mm., orange between black nervures. *Membranule* large, greyish-white, forewing 2, hindwing 4 mm. *Nodal Indicator* $\left\| \begin{matrix} 6 & 5\text{-}6 \\ 4 & 6\text{-}7 \end{matrix} \right|$ first two or three postnodals of all wings not complete. Head dark brown, hairy, a tinge of purplish on vertex and frontal ridge; *front* widely, almost semicircularly, cleft in the middle; *labrum* and *labium* more inclined to fulvous. Thorax dark brown, with grey downy hairs. On each side of dorsal ridge is a band of metallic green; sides also reflecting metallic green or rich steel-colour nearly all over, underside brown. *Legs* rather short, black. Abdomen slender, subcylindrical, 1-2 enlarged, 3 narrow, the rest gradually enlarging to 9, which is nearly as wide as 2. *Colour*: 1-2 very dark brown, auricles of 2 small, semitransparent brown; rest of abdomen rich dark bronze-green (fading to dull blackish in the dead insect). Appendages: *superior* long, 4·6mm., slightly wavy, diverging for 1 mm.; then converging so as to touch at tips; black; apical two-thirds hairy, especially on the inside. *Inferior* short, 2 mm., subtriangular, fairly pointed, tip *very slightly* bifid; semitransparent brownish, darker at tip, which is upcurved (Plate x., figs.4, 10).

♀. Very similar to ♂, but differs from it as follows:—Total length, 50; abdomen, 36·5 mm.; *wings* same length as in ♂, but with a greater amount of saffroning at bases (2 mm. in hindwing). Abdomen thicker and more cylindrical than in ♂; 1-2 slightly enlarged, 3-7 cylindrical, 8-10 slightly enlarged. *Vulvar lamina* of 8, with lateral folds disclosing a triangular area with its apex at the base of the segment, vulvar scale slightly bifid; 9 with lateral folds wide apart, disclosing a semitransparent brown ventral surface carrying two small projecting points; 10 flattish beneath;

very hairy at end. Appendages wide apart, 1·8 mm. long, straight, pointed, black.

Hab.—Waroona, W.A.: very rare. Three males and three females in good condition, taken by Mr. G. F. Berthoud, the captures ranging from the end of November to the third week in December, 1910. Of this dragonfly, Mr. Berthoud writes—"It is a beautiful active insect, found in the same locality as, and with similar habits to *H. berthoudi*; in life, the colour is a rich dark bronze-green with fine metallic sheen, but, in dying, their beauty fades a little." The description given above of the habits of *H. berthoudi* applies also, he says, to this species.

Types: ♂♀, and cotypes, in my collection.

7. Macromia viridescens, n.sp. (Plate x., fig. 11).

♀. Unique. A magnificent species: total length, 66; abdomen, 49; forewing, 51; hindwing, 48 mm.

Wings: *neuration* black, strong; bases saffroned for about 10 mm. in forewings, 5-7 mm. in hindwings. *Pterostigma very small*, 1·5 mm., dull semitransparent brown, scarcely covering one cellule (Plate x., fig. 11). *Membranule* in forewing 2 mm., narrow, greyish; in hindwing 4·5 mm., narrow, pointed, greyish shading to dull brown. *Anal loop* of hindwing containing 16 cells; considerably wider than deep. Head: *eyes* very large, brown; *vertex* highly tubercled, small, brilliant metallic green; *front* downy, deeply cleft medially, rich metallic violet above, shading to brownish near clypeus; *postclypeus* very wide, yellow; *anteclypeus* dark brown, a sharp triangular median portion of the brown mounting into the postclypeus; *labrum* shining black; *labium* very large, brown; *genæ* dark brown. Thorax deep brilliant metallic-green all over, except for a thin yellow dorsal line, a pair of short straight *humeral* yellow bands ending quite 2 mm. before the interalar ridge (which is itself broadly yellow), and, on each side, a fairly broad straight lateral yellow band enclosing the blackish mesospiracle; *underside* brownish; *notum* very dark brown, crossed by the continuous lateral bands. *Legs* black, coxæ brown; numerous long spines on tibiæ. Abdomen

Nodal Indicator	17-18	10-11
	10-11	11-12

cylindrical (rather flat in the type, which is not fully matured), shining metallic-blackish from 6 to 10; 5 showing green reflections; 1-4 brilliant metallic-green; 1, brownish on sides; 2, a pair of small basal dorsal yellow spots, a narrow transverse yellow band interrupted for 1 mm. on dorsum; 3, a fine yellow transverse line close up to the suture; supplementary carinæ on 3-6 black; 4-6 with no markings; 7 with basal half of dorsum yellow; 8-10 with a touch of yellow low down on each side. *Vulvar lamina* with two leaf-like folds or lobes about 1 mm. long, rounded. Appendages 1 mm., black, conical, downy, separated by the triangular end of 10, under which projects a longish irregular tubercle.

Hab.—Cape York, N. Queensland. A unique ♀, taken by Mr. H. Elgner, on November 22nd, 1909, and now in my collection.

It is now necessary to consider further the position of the new Australian genera (described by me in this, and the preceding paper) in the subfamily *Corduliinæ.* These are *Austrophya*, *Austrocordulia*, *Pseudocordulia*, *Hesperocordulia*, and *Lathrocordulia.* This is a difficult task, mainly because of the unsatisfactory state of our knowledge of the *true affinities* of the members of the group *Cordulina,** to which all these genera belong. It must be borne in mind that, in a group of this kind, containing the more highly specialised and advanced members of the subfamily, convergence of forms is very likely to occur. This is particularly the case as regards wing-venation, in forms where the tendency has been towards reduction rather than amplification. In the struggle for existence, it is not always the imago that undergoes the most complete modification; in the *Odonata*, at any rate, there are groups in which the main line of specialisation has been confined to the larvæ, the imagines remaining of a fairly generalised type—and yet there is no reason to believe that such forms are foredoomed to failure. The *Gomphinæ* are a good illustration of this point. Now in the *Corduliinæ*, one can distinguish various tendencies at work, resulting in the formation of what may be termed *strong* and *weak* groups of imagines. For instance, the *Macromina* on the strong side, and the *Synthemina* on the weak side are two successful results of one line of development. Though, in wing-venation, the *Macromina* have progressed far beyond the *Synthemina*, yet the balance is probably maintained by the better larval development of the latter (as I have already shewn, these larvæ resist drought and starvation to a degree hitherto unprecedented in known forms). It has, therefore, occurred to me that, if we knew the larvæ of those forms which I have grouped together in the *Cordulina*, we might find the same "strong" and "weak" tendencies of the imagines (balanced by the opposite tendencies in the larvæ) clearly enough indicated to enable us to subdivide the group into two sections co-ordinate with the *Macromina* and *Synthemina*.

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* In my "Monograph of the genus *Synthemis*" I separated the *Corduliinæ* into *Synthemina*, *Macromina* and *Cordulina*, leaving the latter group for further revision and subdivision if necessary.

As I cannot claim a very intimate knowledge of some of the genera that are not Australian, and as the life-histories of so many species still remain quite unknown, I shall confine this discussion to the Australian genera, together with a few of the better known Old World forms when necessary. A cursory glance at the Australian members of the *Cordulina* suggests, at once, a "strong" and "weak" line of development. The *strong* group, typified chiefly by robust head and thorax, long legs, more or less corduliform abdomen, and elongated anal loop, together with complete recession of the hindwing-triangle to the arculus, is clearly represented by the great genus *Somatochlora* (bipolar) and its offshoots, *Procordulia* and *Hemicordulia*. The *weak* group, typified by smaller head and thorax, short legs, thin nearly cylindrical abdomen, and shortened anal loop, together with incomplete recession of the hindwing-triangle, is represented by *Syncordulia* and its allies, amongst which I number *Austrophya*, *Austrocordulia*, *Pseudocordulia*, and *Lathrocordulia*.

Were these two groups represented by a single type of larva, I should be content to leave the *Cordulina* as a single group coordinate with *Macromina* and *Synthemina*. But the discovery of the remarkable larva X* (the actual species is still undetermined), proves the existence of two larval types, somewhat parallel in their lines of development with those of *Macromina* and *Synthemina*. The larva X belongs to an unknown species, whose venation is *exceedingly close to that of Syncordulia* (until I have actually succeeded in breeding it out, I cannot say definitely whether the species will go into *Syncordulia* or not). In many respects (though certainly not in appearance), it resembles the larva of *Synthemis*. Thus, it is a short thick-set larva, with very short legs, is very inert and fond of concealing itself; it can withstand starvation and drought almost as well as the larva of *Synthemis*, and, in its labial development, it shows irregular and deep incisions. Contrast this with the well-known *Hemicordulia*-type of larva (Needham* has described the larvæ of *Epicordulia*, *Tetragoneuria*, *Somatochlora*, *Helocordulia*, *Cordulia*, and *Dorocordulia*, all of this type).

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* "On some Experiments with Dragonfly Larvæ." These Proceedings, 1910, xxxv., p.667.

There we have a spider-like larva, with large head, broadly oval body, and very long legs; one that relies for protection on its colour-pattern, and lives uncovered on the pond or river-bottom; apparently with no power to endure either starvation, or even a short drought; and with a labial development of the *Libelluline* type, characterised by exceedingly shallow crenations, often armed with sets of tiny spines, and with the lateral lobes often spotted with warts and dots. In general form and habits, these larvæ resemble the *Macromian* larvæ, though the latter still retain the deeply indented labium characteristic of the original *Corduline* stock.

I propose, therefore, to subdivide the group *Cordulina* into two groups, which I am at present inclined to regard as coordinate in value with the *Macromina* and *Synthemina*. But, as these two groups include a larger number of forms, and those more widely distributed over the earth, we must be prepared to find intermediate genera connecting the two main lines of development. Such genera would probably be difficult to place in any linear classification. Also, further knowledge of life-histories may prove the existence of one or more coordinate groups besides these, necessitating further subdivision :—

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* New York State Museum. Bulletin 47, September, 1901. "Aquatic Insects in the Adirondacks."

Group i. Larva with large head and thorax, very long or fairly long legs, broadly oval abdomen; *labium* of *Libelluline* form, with no deep incisions of the outer edge of the lateral lobes, but with shallow crenations generally armed with sets of small spines; lateral lobes often with small warts or dots scattered over the surface; numerous mental and lateral setæ.

Imago with robust head and thorax, long legs, usually more or less corduliform abdomen. *Wing-venation* characterised by large triangles, and forewing-subtriangle, usually all crossed; complete or practically complete recession of hindwing-triangle to arculus; large triangle and forewing-subtriangle; anal loop considerably elongated, with a more or less definite longitudinal bisector..*Eucordulina*.

Group ii. Larva with smaller head and thorax, short or very short legs, large oval abdomen, very flat beneath; *labium* with deep irregular incisions, armed with small spines, but without warts or spots; not many mental or lateral setæ.

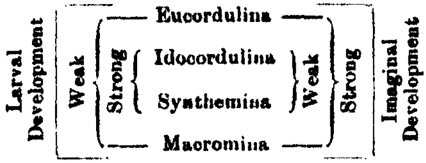
Imago with smaller head, small or moderate thorax, short or very short legs, and usually a slender cylindrical abdomen. *Wing-venation* characterised by incomplete recession of hindwing-triangle; triangles and subtriangle free, and smaller than in Group i.; anal loop short or fairly short; with no longitudinal bisector..*Idocordulina*.

In the *Eucordulina*, I include the following genera—*Hemicordulia*, *Procordulia*, *Somatochlora*, *Paracordulia*, *Dorocordulia*, *Cordulia*, *Helocordulia*, *Epicordulia*, *Tetragoneuria*, *Epitheca*, *Neurocordulia*, *Aeschnosoma*, *Libellulosoma*, *Pentathemis*, *Platycordulia*; also *Oxygastra* and *Hesperocordulia*, which are the connecting links with the *Idocordulina*, but appear to me to deserve inclusion rather in the *Eucordulina;* and finally, *Cordulephya*, for reasons that will be given in a separate paper on that genus.

In the *Idocordulina* I include—*Syncordulia*, *Lathrocordulia*, *Neocordulia*, *Austrocordulia*, *Nesocordulia*, *Gomphomacromia* (*G. paradoxa* Br., but *not G. volxemi* Selys), *Pseudocordulia*, *Aus-*

trophya, *Idionyx*, *Neophya;* and probably also *Idomacrom* about which our knowledge is far too little to make a defini position possible.

The relation of the four main groups of the *Corduliinæ* ma now be illustrated as follows :—



Returning now to the question of *Hesperocordulia* and *Lathrocordulia*, it seems, at first sight, that these two genera are very closely allied. This may be actually the case, or it may be the result of convergence; the point can probably not be definitely settled until the life-histories are known. The important thing is to recognise that, in the natural development of coordinate groups, the *first* divergence or dichotomy must have yielded two closely allied forms; and that it has been the gradual widening of the gap, by development along the two new lines, that provides us with the main characters for our group-classification. Now in the imago of *Hesperocordulia*, we find the *beginning* of the tendency towards an elongated anal loop (the same is shewn in *Oxygastra);* we have a hindwing-triangle practically quite recessed, and we have also a robust development of head and thorax, and very long legs. Place the insect side by side with *Lathrocordulia*, and the remarkable difference in the length of the legs is at once seen. Comparing the two anal loops, the shortness of the loop in *Lathrocordulia* is intensified by its lack of a definite longitudinal bisector; in *Hesperocordulia* the bisector is fairly distinct, and the apical end of the loop is closed by a straight vein. *Lathrocordulia* is clearly very close to *Synocordulia*, and should be placed in the *Idocordulina*, *Hesperocordulia*, on the other hand, in spite of its thin abdomen, is certainly on the road to full *Eucordulina*-development.

The following table shews, at a glance, the more important generic characters of *Hesperocordulia*, and the five Aus genera comprised in the group *Idocordulina* :—

Genus.	Head.	Thorax.	Legs.	Recession of Hindwing-triangle.	Rows of cells after Forewing-triangle.	Sectors of arculus at bases.	Second antenodal in line with arculus or not.	Second cubital cross-vein in Hindwing.	Anal loop.
Hesperocordulia Type, *A. berthoudi*, n.sp.	large	large	very long	practically quite complete	1	apart	no	absent	10-celled, elongated, bisector present, end cut off square.
Lathrocordulia Type, *L. metallica*, n.sp.	large	large	short	not quite complete	1	apart	no	present before arculus	8-9 celled, irregular, no bisector, end not cut off square.
Syncordulia {Type, *S. gracilis* Burm.]	small	small	very short	incomplete	1	apart	no	present at arculus	11-celled, short rounded, no bisector.
Austrocordulia Type *A. refracta* Tillyard	medium	small	very short	incomplete	2	apart	no	absent	7-celled, short, no bisector.
Pseudocordulia Type, *Ps. circularis* Tillyard	medium	small	short	incomplete	1	united	yes	present after arculus*	4-celled, very short, rounded, no bisector.
Austrophya Type, *A. mystica* Tillyard	small	very small	very short	practically complete	1	just united	no	present at arculus	narrow and short, one *row of 4 cells only*.

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*By an unfortunate error, this cross-vein was omitted in the figure of this species in my former paper, *loc. cit.*, fig. 1, Pl. xxii.

EXPLANATION OF PLATE X.

Fig. 1.—Basal portion of wings of *Hesperocordulia berthoudi* ♂, n et sp.
Fig. 2.—Basal portion of wings of *Lathrocordulia metallica* ♂, n.gen. e
Fig. 3.—Appendages of *Hesperocordulia berthoudi* n.sp. ♂, dorsal view.
Fig. 4.—Appendages of *Lathrocordulia metallica* n.sp. ♂, dorsal view.
Fig. 5.—Appendages of *Hemicordulia superba* n.sp ♂, dorsal view.
Fig. 6.—Appendages of *Hemicordulia superba* n.sp. ♂, lateral view.
Fig. 7.—Appendages of *Hemicordulia superba* n.sp. ♀, lateral view.
Fig. 8.—Ventral view of seg. 9 of *Hemicordulia superba* n.sp. ♀.
Fig. 9.—Appendages of *Hespercordulia berthoudi* n.sp. ♂, lateral view.
Fig. 10.—Appendages of *Lathrocordulia metallica* n.sp. ♂, lateral view.
Fig. 11.—Pterostigma of *Macromia viridescens* n.sp. ♀.

[Figs. 1-2, × ; figs. 43-11, × 10.]

Postscript, added August 14th, 1911.—In a letter just received from M. René Martin, the following words are used by him regarding *Hemicordulia novæ-hollandiæ* (I translate from his letter, written in French):—"*Hemicordulia continentalis* differs from *H. novæ-hollandiæ* by the *facies*. It is a smaller, shorter and thicker dragonfly. The thorax is more entirely deep metallic blue above, the abdomen appears quite black above, the yellow colour of the sides is placed lower down and is scarcely visible; whereas in *H. novæ-hollandiæ* the yellow is very broad and apparent. *H. continentalis* is perhaps a race or form of *H. novæ-hollandiæ*, but the facies is very different. In the female of *H. novæ-hollandiæ* in my collection, and that which I have seen, the abdomen is long, not narrowed at segment 2; 2-3 very yellow above; in the female of *H. continentalis*, the abdomen is shorter, narrowed at segment 2, and then cylindrical, with a little yellow on the sides of 2-3; the wings shorter, the thorax more touched with metallic green; segment 10 is nearly all black, scarcely edged with yellow at the extreme tip."

With these words before me, I am still of opinion th
are not specifically distinct. R

ON THE GENUS *CORDULEPHYA.*

By R. J. Tillyard, M.A., F.E.S.

(Plates xi.-xii.)

The genus *Cordulephya* was first proposed and defined by de Selys in his "Synopsis des Cordulines," 1871,* for the reception of the interesting little Australian species, *C. pygmæa* Selys. In that work he describes the male type only, from Melbourne. But, in his "Additions au Synopsis des Cordulines," 1874,† the same author adds a very short description of what is evidently a very immature female, in the British Museum, also from Melbourne

Later on, Mr. Billinghurst discovered this insect in considerable numbers on the Goulburn River, at Alexandra, Vic., and sent a number to Europe. In 1905, when I began to study the Australian *Odonata*, this was one of the first insects which I took, the locality being Otford, Illawarra district, N.S.W. It appeared to be very rare there. But in 1907, very late in the season(April and May), I found it in great numbers at Lily Vale, only two miles from where I first took it. In the following years, I traced it to other localities, extending its range to the foot of the Blue Mountains, and also obtaining the larva and studying its life-history.

In January, 1910, while collecting at Medlow, Blue Mountains, I noticed several specimens of what I took to be this same insect. As I had a large series, I did not trouble to secure any, until it occurred to me that it was very peculiar that, at so great an elevation, it should be out on the wing in January, whilst lower down along the coast it did not even begin to appear until late in February. I, therefore, secured a pair for comparison with my series of *C. pygmæa.* I was greatly surprised to find that these were a very distinct, though closely allied, species. So far, I have been unable to secure further specimens of the imago, but during a visit to Medlow, in November, 1910, I obtained two nearly full-fed larvæ. I have, therefore, practically complete material for a paper on this most interesting aberrant genus.

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* Acad. Belgique. xxxi., 1871, p.315.

In this paper, I propose to follow the lines of my "Monograph of the genus *Synthemis*"* in giving, besides full descriptions and life-histories of the two species concerned, a discussion of the position occupied by the genus in the subfamily *Corduliinæ*, and an attempt to solve the difficult problem of placing it in its correct position in a linear classification. As with *Synthemis*, so with *Cordulephya*, it will be found that a knowledge of the life-history is an indispensable part of the data on which any conclusion should be based. Even if, as will be seen to be in some measure the case in this paper, the larval form does not fit in with our preconceived notions and expectations—derived from the study of wing-venation only—we must accept the facts as they are, and try still to solve the problem which our knowledge has only rendered more difficult.

As a careful comparison of the two species of the genus will throw a good deal of light on the question of classification, I propose to give descriptions and life-histories first. So that the comparison may be made more easily, I will place the descriptions side by side in tabular form.

Genus CORDULEPHYA de Selys.

The characters of the genus, as given by de Selys, are partly based on variable venational characters, and, therefore, need enlargement, not only to include the new species, which is essentially congeneric with the type *C. pygmæa*, but also to admit variations of the type-species itself. The locality (Melbourne) of the types is unfortunately at the extreme southern end of the range of the species. Hence the measurements given by de Selys disclose the fact that practically every other specimen from more northern localities is considerably larger than the type-specimens. More than this, variations in venational characters, used to define the genus, are not only due to difference in locality, but are an essential characteristic of the species; so that a long series, *taken from any given locality*, can be arranged to show a gradation from one extreme to the other. The chief variation lies in the form of the triangle of both wings. De Selys defines them as follows:— "Le triangle discoidal des ailes supérieures irrégulier, le côté supérieur brisé, ce côté formant un angle obtus dirigé vers la côté;" and, as he says nothing about the hindwing-triangle, it is, of course, to be assumed that the definition "regular" applies to it in this as in all other genera of the subfamily. An examination of a long series of *C. pygmæa*, however, discloses the fact that a *regular* triangle in the hindwing is rather the exception than the rule. In the majority of specimens, the superior (costal) side of this triangle is *distinctly broken* near the distal angle (Plate xii., figs. 3 and 4), and, in a few specimens, the break is even more than one-third of the whole length of the side from the distal angle. Another variable character is the position of the arculus-sectors at their base. De Selys defines them in the words (for the hindwing only) "l'arculus dont les secteurs naissent séparés." This is scarcely the case. In the forewing they are frequently *just separated*, and as frequently *just joined*. In the hindwing, however, they are usually *just joined*, and, in some specimens, *joined for a perceptible distance*. This may be clearly seen in the photograph of the wings given in Martin's "Cordulines,"* though he does not comment upon it. [It should be here noted that the drawing of the wings of *C. pygmæa*, given by Needham in his "Critical Notes on the Classification of the

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* These Proceedings, 1910, xxxv., p.312.

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* Coll. Zool. du baron Edm. de Selys-Longchamps, Fasc. xvii., *Cordulines*, Bruxelles, 1906.

Corduliinae,"* and stated to be "after Martin," is entirely erroneous and misleading, both as regards the *complete* fusion of the arculus-sectors, and the position of the "break" in the costal side of the forewing-triangle. Such conditions as are shewn in this drawing do not, I venture to state, exist in a single specimen of *C. pygmæa* in any collection.]

In considering the new species, which I propose to name *Cordulephya montana*, we find a further modification necessary. De Selys says "Membranule nullo" for *C. pygmæa*. But, in *C. montana*, there is a small but quite clearly defined membranule. I, therefore, offer the following amended description of the genus. Basilar, median, and hypertrigonal spaces free. All triangles free, followed by a single row of post-trigonal cells for at least part of the discoidal area. Costal side of all triangles variable; that of forewings *always* broken, usually close to distal angle; that of hindwings sometimes complete, but more usually broken very close to distal angle. Sectors of arculus variable at their base, usually either *just* separated or *just* joined. Basal side of triangle of hindwings placed distally from arculus. Membranule small or obsolete. Anal border of hindwing of male not excavated, oblique, nearly straight, without a cross-nervule across the anal triangle; forming a very obtuse angle with the posterior margin of the wing. Female with no ovipositor. *Hindwing of both sexes very narrow at base, possessing a small and exceedingly reduced "anal loop" of from 2-4 cells only, with outer margin not strongly developed.*

The addition of the characters in italics is essential. They are, in my opinion, the most important of all for distinguishing this genus from all others in the subfamily.

Type of genus, *C. pygmæa* Selys.

The following is a detailed description of the two known species, arranged in tabular form to facilitate comparison. The description of *C. pygmæa* is taken from my own series, which accounts for the measurements being larger than those given by de Selys:—

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* Ann. Ent. Soc. America, i., No.4, Dec., 1908.

	C. pygmæa Selys.	*C. montana*, n.sp.
Total length	♂ 31-37 ♀ 31-33 mm.	♂ 36 ♀ 37 mm.
Abdomen	♂ 22-27 ♀ 22-24 mm.	♂ 26 ♀ 26 mm.
Forewing	♂ 22-23 ♀ 25-26 mm.	♂ 26·8 ♀ 28·5 mm.
Hindwing	♂ 21-22 ♀ 24-25 mm.	♂ 24·5 ♀ 27·2 mm.
Wings:—		
Triangle of forewing	Costal side shorter than other two, broken distally, usually at one-third or less from distal angle.	Costal side as long as other two, broken close to distal angle.
Triangle of hindwing	Costal side equal to distal side, but greater than basal side; sometimes complete, but more usually broken near distal angle.	Costal side considerably longer than the other two, just broken very close to distal angle.
Cross-veins in cubital space	one in forewing; *two in hindwing, one on each side of arculus.*	one in forewing; *one only in hindwing;* about half way between base and arculus.
Number of antenodals	Forewing, 9-10 all complete and regular. Hindwing, 7-8 all complete and regular.	Forewing 9-11 all complete, but last one irregular. Hindwing 8, all complete.
Number of postnodals	Forewing 6-7, irregular, first one or two incomplete. Hindwing 6-7, irregular, first one or two incomplete.	Forewing 7 irregular, first one or two incomplete. Hindwing 6-7 irregular, first one cr two incomplete.
Supplementary cross-veins at bridge	None.	None.

Pterostigma	thick, black or dark brown, paler along costa. ♂ forewing 1·4-1·6, hindwing 1·7-1·9 mm. ♀ forewing 1·7-1·9, hindwing 1·8-2·0 mm.	thick, black or dark brown, paler along costa. ♂ forewing 1·9, hindwing 2·1 mm. ♀ forewing 2·0, hindwing 2·2 mm.
Sectors of arculus ...	usually *just united* at base in forewing, united for a short distance in hindwing.	just touching at base of both wings.
Arculus	straight.	distinctly bent, portion above sectors slightly convex to base of wing.
Membranule	nil; replaced in hindwing by a small tuft of hairs.	♂. forewing nil, hindwing nearly 1 mm., very narrow, greyish. ♀. forewing small, hindwing nearly 1mm., broader.
Anal angle of hindwing in male	very obtuse; distal side of anal triangle reaching margin well before anal angle.	not quite so obtuse; anal triangle longer, with distal side reaching margin closer to anal angle.
Anal loop of hindwing	♂♀. two large cells, outer border irregular.	♂. 3 cells, first one large; outer border nearly straight ♀. 4 cells first one large, outer border nearly straight
Number of rows of cells following triangle of forewing	generally a single row complete nearly to wing-border; sometimes one or two of the broadest cells near middle of row subdivided into two by a straight sector; a few smaller cells at border of wing.	♂. 5 single cells, then 5 double, then 4 single with two bifurcated veins. ♀. 6 single, then 5 double, then 5 single; three or four smaller cells at border of wing.
Supplementary radial sector	absent in forewing, present in hindwing, converging towards M_3 and reaching the wing-border.	absent in both wings.

[For comparison, see also Plate xii., figs. 1-6.]

Head:—		
Vertex	small, tubercled, metallic purplish-black.	same as in *C. pygmæa.*
Antennæ	short, black.	
Front	depressed medially, hairy, dark metallic purplish.	
Clypeus	shining black, a narrow yellow band on anteclypeus.	
Labrum	black.	
Labium	yellow.	
Thorax:—		
Prothorax	small, downy, blackish.	same as in *C. pygmæa.*
Meso- and metathorax	hairy above; black, with steely reflections on basal half; a fine yellow line along dorsal ridge; interalar ridge yellowish; a pair of orange-yellow antehumeral stripes placed well forward, rather broad and short, 2 mm. long by 1 mm. broad. Sides steely black with a broad lateral band of orange-yellow, and a yellow area close to abdomen, under hindwing-base. Scuta and scutella yellowish.	generally similar to that of *C. pygmæa*, but with the antehumeral stripes less distinct, longer and narrower, and perceptibly curved inwards.
Legs	long and slender; anterior tibia of male with a long narrow lamella underneath, and with an irregular armature of long and short spines (Plate xii., fig. 45); ditto of female without lamella, and with more regular armature. Colour black, coxæ and bases of profemora brown.	as in *C. pygmæa*, but foreleg *much longer* in all its parts.

Abdomen of Male:—

Shape	♂. long and narrow, 1-2 and 7-10 slightly enlarged.	♂. not so long for size of insect, slightly stouter, 1-2 and 7-10 somewhat more enlarged.
Auricles	distinct, almost hooked (interior side concave); yellow with a touch of black at tips, which are rounded.	not so much hooked, interior side almost straight, tips slightly pointed inwards; yellow.
Genitalia of ♀	deeply recessed within a large oval depression, the borders of which carry long grey hairs, most abundant at apical end. Seen in profile, the raised border completely hides the genitalia.	similar, but not so deeply recessed; the borders are slightly less raised, so that in the profile view a small part of the genitalia is seen protruding.
Colouration	orange-yellow and black as follows:— 1, yellow 2-7, basal part yellow, apical part black, the two colours separated by a very straight transverse line, placed in 2-3 half-way, 4 slightly before half-way, 5-6 about one-third from base, 7 not quite half-way; in 3-7 the black of the preceding segment just overlaps the suture, so as to form a narrow black basal band continuous in colour. 8, black, with two basal yellow spots conjoined dorsally. 9-10 quite black.	orange-yellow and black as follows:— 1, yellow shaded with brown. 2, basal half yellow, apical half black with a yellow central portion. 3, considerably over one-half from base yellow, rest black. 4, basal half yellow, rest black. 5, basal one-third yellow, rest black. 6, basal one-third yellow, rest black, but the division between the colours not distinct, the black encroaching on the yellow dorsally. 7, yellow for nearly two-thirds from base, rest black. 3-7 with the divisions between the colours neither so straight nor distinct as in *C. pygmæa*; black of previous segment slightly overlapping each suture. 8-10 as in *C. pygmæa*.

Appendages	*Superior* 1·5 mm., black, slightly hairy, nearly parallel, subcylindrical; tips bluntly pointed, usually converging slightly; a small dorsal spine at base, a more conspicuous tooth or projection beneath, about one-third from base. *Inferior* 1·2 mm., black, fairly broad upcurved, slightly hollow above, tip squarely truncated; a flat hairy tubercle on 10 beneath. (Plate xii., figs.7, 8, 13).	*Superior* 1·8 mm., black, hairy, converging, thicker near base than towards tips, which are slender, touching, and slightly upcurved; a small dorsal spine near bases and two small projections beneath, about one-third from base. *Inferior* 1·1 mm., black, broad at base, hollow above, narrowing to tip, which is rounded and upcurved; a conspicuous double hairy tubercle on 10 beneath. (Plate xii., figs.9, 10, 14).
Abdomen of Female:		
Shape	stouter than in ♂, cylindrical.	same as in *C. pygmæa*.
Colouration	1-6 as in male, but in 6 the colour-division is not distinct. 7, with a basal yellow band encroaching dorsally on the black of next segment. 8, black, with two small basal yellow spots. 9-10, quite black.	1-6 as in male. 7, basal half yellow, rest black. 8-10 quite black.
Genitalia	No projecting ovipositor; underside of 8 not overlapping 9; marginal folds of 9 narrow, leaving the whole segment open and concave.	No projecting ovipositor; underside of 8 not overlapping 9; 9 with basal third only concave and uncovered, rest enclosed by a somewhat trifid fold.
Appendages	0·6 mm., straight, black, downy, tips rounded, separated by a double rounded tubercle on 10 below and between them. (Plate xii., fig.11).	0·8 mm., straight, black, hairy, tips well rounded; a large rather elongated tubercle projecting above and between them, and below it two smaller rounded tubercles, on 10. (Plate xii., fig.12).
Types:—	♂. Coll. MacLachlan. ♀. British Museum.	♂♀.(unique).Coll.Tillyard.

Hab.—*C. pygmæa* ranges from Melbourne up to the central coast of New South Wales. In Victoria it has been taken well inland at Alexandra, but in New South Wales all the recorded localities are within fifty miles of the coast. The following is a list of the localities:—Melbourne(♂♀.types), Alexandra(numerous examples taken by Mr. Billinghurst), Illawarra district, N.S.W., (Otford, Lily Vale, Heathcote, a large number taken by myself), Sydney District, N.S.W.,(Duck Creek, Auburn, fairly common), Nepean River and tributaries(Glenbrook, Menangle), Ourimbah (common). It emerges at the end of February, is most abundant during March and April, and may be taken right through May and June.

The only known locality for *C. montana* at present is Medlow, Blue Mountains, N.S.W., where I took the type-male and female on January 19th, 1910. From the appearance of the specimens, I should say that they had been on the wing considerably over a month (the border of the wing of the ♂ is slightly torn in one or two places). The fact that larvæ found on November 5th, 1910, were practically full-fed, leads me to give the middle or end of November as the probable date of emergence of this species. It probably does not continue on the wing beyond February.

Life-History of C. pygmæa.

On any warm still day in March or April, the female may be seen ovipositing in her favourite haunts. These are the little grass-fringed bays and corners that occur occasionally along the creeks in the hilly country round Sydney. The oviposition is carried out as follows. Suddenly, from the top of some bush or tree where she has been resting, the female will dart down to the water, and, in a most hurried and restless manner, begin to wash out the eggs, in large clusters, from the open vulva of segment 8, which is quite unprovided with any projecting ovipositor. This is done by continual wavings up and down of the abdomen, each downward stroke bringing it in contact with the water. During the whole time the flight of the female is so bewildering that it is difficult to follow, and so rapid is their motion that I have often seen the body of the insect poised with the wings practically invisible. A swaying and almost pendulous-like motion backwards and forwards is kept up at the same time, so that the movements of the insect are almost impossible to follow. The only way to capture the female at such a time is to knock it, if possible into the water, and draw it into the bank with the net.

After ovipositing in this manner for a few minutes, visiting perhaps from fifty to one hundred yards of the borders of the stream, the female will suddenly rise with great swiftness, and disappear as quickly as it came.

A female, which I was fortunate enough to capture at Lily Vale, in May, 1907, immediately exüded an enormous cluster of eggs into a glass phial filled with water. There must have been nearly a hundred in the one mass, and she continued to exude large masses every few minutes. So that it seems that one of these females must, at a moderate estimate, lay several thousand eggs. These eggs are exceedingly interesting, for they are the only *Odonate* eggs known to me which possess a sculpture or surface-markings. Under a lens, they are seen to be irregularly pitted all over with shallow oval depressions, giving the whole egg a mottled appearance(Plate xi., fig,6). Their colour is orange-brown; length 0·3, breadth 0·2 mm.; in shape a prolate spheroid. They are fastened together in a glutinous mass; each egg carries at one pole a small stem, and at the other a large gelatinous cap, as shown in the plate.

I kept some of these eggs in a Petri-dish for three weeks, during which time they gradually darkened in colour, becoming a deep brown. The eyes of the young larva could clearly be perceived, and they were evidently within a few days of hatching, when I lost them all from an attack of fungus.

Partly grown larvæ can be found from September to December, but the end of January and beginning of February are the best times to secure the full-fed nymph. At that time the only other *Odonate* nymphs which have not emerged are those of *Caliaeschna conspersa*, and the second brood of *Diplacodes hæmatodes*, These three inhabit different parts of the creek-bed; so that it seems that the larva of *Cordulephya* has been forced to accommodate itself to a very late period of emergence in order to escape the rapacity of the large *Aeschnid* nymphs, which are common along the creek-borders earlier in the season, I have found that, in this respect, the larva of *Aeschna brevistyla* is the most to be feared, as it often frequents old sticks and trash on the creek-beds, and will even attack such large nymphs as those of *Hemicordulia tau* and *H. australiæ*.

The full-grown nymph of *Cordulephya pygmæa* is, in outward appearance, very similar to the nymph of *Hemicordulia australiæ*, though not so large. It is remarkable in possessing a labium unlike that of any known larva, and one which shews, in a very peculiar manner, both *Corduline* and *Libelluline* development. The following is a full description.

Total length, 14 mm.; *head*, 2 by 4 mm. wide; *thorax* 4 mm. wide; *abdomen* 5 mm. wide at broadest part (segment 6). *Legs* (measurements for femur, tibia, and tarsus respectively) fore, 3·5, 3, 1·7 mm.; middle, 4·3, 4, 1·9 mm.; hind, 5, 4·2, 2·1 mm.(these measurements coincide almost exactly with those for the imago).

Head: triangular in front, with eyes placed at extreme antero-lateral angles; postocular areas fairly well rounded, with a conspicuous tuft of hairs on the outer margin; *ocelli* fairly conspicuous; *antennæ* long, 3 mm., slender, 7-jointed, first two joints shorter and thicker than the other five. Labium: *mentum* 4 mm. wide, narrowing rapidly to 2 mm. at basal joint; *median lobe* forming a very obtuse angle in middle; *mental setæ*, 11 on each side, longest about 1 mm., shortest 0·3 mm. *Lateral lobes* subtriangular, strongly built, outer margin 3 mm., inner margin 2·5 mm.; *lateral setæ*, 8, about 1 mm. long; *terminal hook* slender, 1 mm. *Distal border* with very remarkable indentations. Beginning from the terminal hook, on one lobe (usually the left) there is a small indentation followed by three very deep and narrow clefts, rounded at their bases, and isolating two long and narrow projections or teeth, which are also well rounded at their tips; the remainder of the border carries four much smaller rounded teeth with shallow angulated depressions between them; on the other lobe (usually the right), the first indentation is fairly deep, then follow two very deep indentations or clefts of the same shape as on the left, and next a fourth cleft only slightly deeper than the first; the rest of the border carries three much smaller rounded teeth similar to those on the left. The margins of all these teeth are very finely crenulated, and at their tips they are furnished with from two to four short spines, of which the one nearest the terminal hook is the least, and the one farthest from it the greatest (when there are four, however, the fourth may be small also). The whole inner surface of the lateral lobes is irregularly spotted with small black warts and dots, and there is a row of tiny hairs along the inner margin. The lack of symmetry in this remarkable labium is, of course, only to be expected, to enable the two lobes in the position of rest to fit into one another [Plate xi., fig.3, outline of lateral lobe; fig.4, underview of head, shewing labium in position of rest, with lateral lobes placed so that the tip of each long tooth just rests in the opening of the opposite depression]. Thorax well built, with a sharply angulated, transverse, prothoracic ridge; sides of metathorax well rounded. *Wing-cases* 5 mm., reaching to beginning of sixth abdominal segment. *Legs* with a very few fine hairs on tibiæ. Abdomen oval, well rounded above; underside slightly convex, with a longitudinal depression along each side. No dorsal spines. *Lateral spines* as follows—6, a very tiny spine on each side; 7, a fairly large and conspicuous curved spine; 8-9, still larger curved spines, quite 0·5 mm. long; 9 with anal border hollowed to enclose 10, which is very short. *Appendages:* superior short, broadly triangular; two lateral of same length but narrow and rather pointed; involucra of imaginal appendages somewhat shorter, lying between lateral and superior appendages. Colour-Pattern: this varies a great deal, both in intensity and detail, according to the locality, and also in individual specimens. An average nymph may be described as having a dark brown abdomen, beautifully mottled all over with lighter brown; the head, thorax, legs, and wing-cases being light brown, with dark brown markings. The most conspicuous of these are: on the head, a dark transverse band between the eyes; on the legs, short patches of dark shading, three or four on femora and tibiæ, two or three on tarsi; on the wing-cases a dark basal patch, a black slanting line on the nodus, followed by a large dark patch. On the abdomen, the pale colouration consists of a fairly regular dorsal band, pale transverse basal lines on each segment, and a series of slanting semi-oval marks on each side of segments 4-8. For general appearance of this nymph, see Plate xi., fig.1 (*C. montana*), the chief difference being that, in *C. montana* the forelegs are much longer by comparison, for the size of the nymph.

The most beautifully marked nymphs are those which occur in the clear mountain-creeks, such as the creeks at Heathcote and Lily Vale, in the Illawarra district. In the more muddy creeks, such as Duck Creek, Auburn, the pattern of the nymphs is generally much less pronounced.

The habits of this nymph are very similar to those of the nymphs of *Hemicordulia*. It lives *on* the sandy bottom of the creek, lying hidden in the sheltered corners away from the main current of water. It never burrows nor buries itself in the sand; but relies for capturing its prey on its protective colouration—which suits its habitat remarkably well,—on its long and agile legs, and on its powerful labium. I have fed them on mosquito-larvæ, water-fleas, and small *Agrionid* nymphs, all of which they devour greedily. They can, however, go without food for fairly long periods, though I do not think that they can withstand any degree of drought.

When emerging, the nymph crawls up the bank of the creek, often very steep, or even overhanging, and then ascends the grass or reed-stems near by, often travelling a foot or more up the stem. In the aquarium, they find it very difficult to ascend a single reed-stem, but climb up mosquito-netting quite easily.

The imago, when newly emerged, has a very peculiar colouration, the eyes, pterostigma, and thorax being a kind of livid-grey. This colouration persists for some days, so that one can tell from it whether the insect is immature or not. The immature insects fly away into the bush, generally settling high up on the branches or trunks of trees, with their wings folded. The habits of the mature imago are very peculiar. It seldom flies for long at a time, and may usually be found settled upon a rock in the stream-bed, or on the trunk of a neighbouring tree, with its wings folded close along its back, just like an *Agrionid*. On a warm day in late summer or early autumn, it is most interesting to watch these insects. At Lily Vale, in April, 1907, they were particularly numerous on the creek. Nearly every rock was tenanted by one or more males, the females being always excessively rare, and practically never seen except when ovipositing. Every few minutes a male would fly up, indulge in a short and very bewildering zig-zag flight, and then settle down on another rock. Often the males would disturb one another, and the two together, flying up, would indulge in the most fantastic evolutions, generally ending in a wild flight away into the trees. It is very seldom that a pair are seen together; I have several times seen a female dash rapidly down from the trees, as if to oviposit, and then be seized rapidly by a male, whereupon they would immediately fly off in the same wild zig-zag manner into the trees. Later in the day, and often throughout the day in late autumn, the males leave the creek, and seek out a sunny tree-trunk in some open glade of the bush. Here they will sit and sun themselves, occasionally making short flights, but always returning to the sunny patch on the tree-trunk. As the shadows lengthen in the afternoon, and the sunny patch gets smaller and moves slowly up the trunk, these insects follow it in the same manner that I have seen butterflies of the genus *Xenica* or *Heteronympha* behave; so that often several will be at rest close together, high up on the trunk. Finally, as the sun gets lower, they fly off one by one, and disappear into the forest.

Life-History of C. montana.

The few facts that I have been able to observe with regard to this species, shew that, on the whole, the life-history is very similar to that of *C. pygmæa*. The most important difference is that the eggs are laid during January (the type-female was captured while ovipositing), and that the larvæ are full-fed early in November; so that the imago is on the wing in December and January, instead of late in the season. Now this is a very interesting fact, because, on the Blue Mountains, at a high elevation, the local *Aeschnidæ* (of which *Austroaeschna parvistigma*, var. *multipunctata*, is the commonest) appear *late* in the season, and their larvæ are not more than half-grown by the time that of *C. montana* is full-fed. Hence we have a striking instance of two closely allied species adapting themselves to circumstances, in two opposite ways, which achieve the same end; viz., along the coast, where the commonest *Aeschnid* emerges very early in the season (*Aeschna brevistyla* is on the wing from October to December) we have *C. pygmæa* emerging late; whereas on the mountains, where all* the *Aeschnidæ* emerge late, we have *C. montana* emerging early. This may seem remarkable, in view of the fact that the mountain-climate is so much colder, and the season so much later. But if we consider the fact that the mountain-*Aeschnidæ* are on the wing right to the end of February, by which time the season for dragonflies is practically over, and the weather getting cold again, we shall see that the early emergence of *C. montana* was absolutely necessary to preserve the species.

I offer, for what it is worth, an interesting theory to account for this discrepancy. It is well known that our commonest species of the *Corduliinæ*, *Hemicordulia tau*, is distinctly double-brooded. They emerge in great numbers from September to November, and then again in February and March, or even April. The second brood, however, is not so constant as the first in point of abundance, being usually less numerous, though occasionally, for some unexplained cause, exceedingly abundant. Now, in the habits of its early stages, *Cordulephya* resembles *Hemicordulia* very closely. Assuming then that there was a time when the former was much more common than it is now, and that it originally occupied, in the Australian *Odonate* fauna, somewhat the same position that *Hemicordulia* does at present, we may suppose that the members of the genus were all double-brooded. Both the coastal and mountain-forms then, though they may not at that time have been specifically distinct, were faced with their own most formidable foes in the shape of numerous ravenous *Aeschnid* larvæ. On the coast, the swarms of larvæ of *Aeschna brevistyla* gradually exterminated the *early* brood of *C. pygmæa*, while, on the mountains, the late-developing larvæ of *Austroaeschna parvistigma* destroyed the second brood of *C. montana*. That this one circumstance, in itself, may have played a large part in the differentiation of the two species is very probable.

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* I ought to except *Æ. brevistyla*, which occurs *very sparingly* on the mountains, and is on the wing in December; but it is not at all common there.

I find, on referring to my notes on *C. pygmæa*, that this theory is supported by the fact that, in October, 1907, I dredged, from the creek at Lily Vale, several very small larvæ of *C. pygmæa*, which were, however, *fully developed*. I did not know at the time to what species they belonged, but the fact that their wing-cases were so long, *reaching nearly to the end of the abdomen*, struck me as being so peculiar, that I made a note of it. On examining the labium, I determined the larvæ as those of *C. pygmæa*. Now I have never seen the imago out before February. It is not unreasonable, therefore, to suppose that many of the larvæ produced from the late brood, feed up rapidly, and are in a fair way to become a *first* brood for the next season. But here the enemy, the rapacious *Aeschna* larvæ, has to be reckoned with. Those that escape him, must hide away in obscure corners, and probably have to undergo a prolonged fast for many weeks, until the *Aeschna* larva has become full-fed and emerged. Supposing that the ecdyses take place as usual, we should then have the spectacle of a poor, miserably undersized larva, with huge wing-cases,—in fact, just such a one as those I took at Lily Vale. These larvæ most certainly did not emerge until the end of February, for I visited Lily Vale every month up to April, and saw no imagines until the beginning of March. Here also may be found the explanation of the remarkable difference in size between the larvæ of *C. pygmæa* and *C. montana*, a difference quite unwarranted by the small difference of size in the imagines. For the larva of the latter, having no fear of *Aeschnid* larva, can feed up and develop rapidly, and so attain a much larger size.

The full-fed larva of *C. montana* (Plate xi., fig. 1) differs principally from that of *C. pygmæa* in the following points.

1. The great length of its forelegs. These are foreshortened in the plate, as the insect sits with the femur and tibia bent up at an acute angle. The actual measurements are: femur, 4·7, tibia 4·8, tarsus 2·5 mm. For the middle leg, the corresponding measurements are 6, 5, 2·5 mm.; and for the hind leg, which is also extremely long, 7, 6, 3·2 mm.

2. In the labium (Plate xi., fig. 2) the dentition of the *right* lateral lobe is similar to that of the *left* in *C. pygmæa*, and *vice versâ*. This is not important, however, as I have only examined two larvæ of *C. montana*, and the character may not be constant.

3. In the labium also, there is a peculiar development of *double* mental setæ, which I have not observed elsewhere. In the figure, for example, there are thirteen mental setæ on each side; but, on the right side, two pairs are grouped together so as to touch from their bases upwards. If these had coalesced, we should have had *eleven* setæ, the number found in *C. pygmæa*.

4. The greater size of the larva, whose total length is 17 mm., compared with 14 mm. for *C. pygmæa*, and correspondingly larger in all parts.

Structure of the Larval Gizzard (Plate xi., fig. 5).

This is essentially of the *Libellulid* type, with four fields shewing bilateral symmetry. A comparison with the gizzard of *Synthemis eustalacta* ("Monograph of the genus *Synthemis*," fig. 2, p. 326) shews two important differences.

1. In the two inner folds, the upper tooth is much larger, sharper and more prominent in *Cordulephya* than in *Synthemis*.

2. In the two outer folds, the outer lateral edge of the tooth carries only three minor teeth or serrations, whereas in *Synthemis* there are four or five. In this latter respect, the gizzard of *Cordulephya* differs from those of all other *Libellulidæ*, which I have examined. I know of no other gizzard with less than four serrations, and some have as many as six or seven. (The figure in the plate is the gizzard of C. *montana* × 20).

As the form of the gizzard is practically constant throughout the *Libellulidæ*, it is clear that these two differences, small as they are, shew that *Cordulephya* and *Synthemis* are not closely allied,—a conclusion which a comparison of both larva and imago in every detail will manifestly strengthen. On the other hand, the gizzard of *Cordulephya* resembles that of *Hemicordulia tau* very closely, though the latter, of larger size, possesses *four* serrations, instead of three, on the lateral edge of the single tooth in the outer fold.

The Position of Cordulephya in the Subfamily Corduliinæ.

The four main groups of the subfamily *Corduliinæ*, have been already pointed out in two previous papers,*

GROUP i. EUCORDULINA. *Larva* smooth, with large head and thorax, long legs, labium of *Libelluline* form, *i.e.*, with lateral lobes possessing shallow crenations along outer edge, with surface marked with small warts and dots, and with numerous mental and lateral setæ.

Imago usually of strong flight, with robust head and thorax, long legs, usually corduliform abdomen; wing-venation with large triangles and subtriangle (of forewing), usually crossed, complete or practically complete recession of hindwing-triangle, and elongated anal loop, shewing a definite longitudinal bisector.

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* "Monograph of the Genus "*Synthemis*," These Proceedings, 1910, xxxv., p.328.—"*Further Notes on some rare Australian Corduliinæ*" These Proceedings, 1911, p.384.

GROUP ii. IDOCORDULINA. *Larva* smooth; with smaller head and thorax, short legs, very flat labium; labium with deep irregular incisions, no warts or dots, and few mental or lateral setæ.

Imago usually of weak flight, with smaller head and thorax, short legs, usually slender cylindrical abdomen; wing-venation with smaller free triangles and subtriangle, incomplete recession of hindwing-triangle, fairly short or quite short anal loop, shewing no longitudinal bisector.

GROUP iii. MACROMINA. *Larva* smooth, with nearly circular and very flattened abdomen, very long legs, head with a pyramidal frontal horn; labium with deep dentition of lateral lobes.

Imago: large insects of strong flight, and robust development; wing-venation with small triangles far removed from arculus, basilar space free, anal loop broad and compact.

GROUP iv. SYNTHEMINA. *Larva* very villose, with elongate-oval body, short legs, and divergent wing-cases, head square in front, with projecting eyes. *Imago:* insects of weak flight, and slender-build; wing-venation with dense or fairly dense reticulation, basilar space reticulated, hindwing-triangle usually not retracted to level of arculus, anal loop very broad and short, never as long as wide.

The genus *Cordulephya* is obviously not at all closely related to either the *Macromina* or *Synthemina*. We should, therefore, consider whether it is closely enough allied to either the *Eucordulina* or *Idocordulina* to warrant its inclusion in one of them; or whether, perhaps, it shews a sufficiently independent development to deserve coordinate rank by itself. This is a very difficult problem, as it will be seen that the evidence is in many respects contradictory. It is, however, a problem of deep interest, and brings out some very interesting points in *Odonate* evolution. I propose to consider the evidence in detail afforded by the consideration of (i.) the early stages, (ii.) the form of the imago, (iii.) the wing-venation. (iv.) a comparison of the two known species of the genus.

i. *The early stages.*—A glance at the figure of the nymph of *Cordulephya montana* (Plate xi., fig. 1) will shew us, at once, its remarkable resemblance to the larvæ of the *Eucordulina*-group. In the shape of its head, the build of head and thorax, the general form of the abdomen, the long, spider-like legs, and the mottled colour-pattern, this nymph and that of *C. pygmæa* are exactly like those of *Hemicordulia*. They most closely approach the nymph of *H. australiæ*, from which they differ only in their slightly smaller size, their remarkable labium, and the absence of small dorsal hooks (the latter is purely a specific character, as it is absent in the larvæ of *H. tau* and *H. superba*). The form of the gizzard, too, is very close to *Hemicordulia*, especially in the relative sizes and shapes of the teeth on the inner folds.

We must now consider separately the remarkable labium of *Cordulephya*, which is, at first sight, so different from that of any known species. If we look at the outer border of the lateral lobe (Plate xi., figs. 2-3), we shall see that, although the upper half is very deeply indented, yet the lower half closely approximates to the form shewn in *Hemicordulia* and allied genera. In fact, if the deep incisions of the upper half were closed up by a wavy line, drawn so as to continue the shallow crenations of the lower half, we should then have a typical labium of the *Eucordulina*-group, with full development of lateral and mental setæ, warts and dots on lateral lobes, and sets of small spines on each shallow crenation. It is interesting to note (Plate xi., fig. 4) that the deep upper incisions are not made so as to fit closely into one another (this would be impossible unless the *whole* outer surface were also deeply incised), but that they lie, in the position of rest, just with their rounded tips resting in the tops of the opposite hollows. It is, I think, evident from fig. 4 that, as the labium is now constituted, the persistence of the deep incisions must be a disadvantage to the nymph, since the smaller prey can slip through the openings left by them. I conclude, therefore, that these deep incisions are an archaic character which has persisted in *Cordulephya* alone, of all present-day *Libellulidæ*. [As such, they open to our view a most fascinating vista of the development of the *Anisopterid* labium along its two main lines, viz., the *Libellulid* and the *Aeschnid* forms.]

Turning now to the *Idocordulina*, we notice that the larva of *Cordulephya* shews not the slightest resemblance to the larva X, which we have taken as typical of that group. In this larva, the general form (large oval abdomen, very flat; short legs, small head and thorax), and the labial development (a widely and irregularly torn outer edge, no warts or dots, and few setæ), make it almost impossible to believe that *Cordulephya* is a member of this stock.

In its habits, the nymph of *Cordulephya* is altogether *Eucordulian*. A denizen of the secluded corners of streams, living quite uncovered on the sandy bottoms, it is able to move with considerable speed, and possesses a peculiar and fascinating mode of swimming, which may be aptly compared to the first regular strokes taken by a frog after diving,—fore-legs outstretched, and hind-legs taking slow and graceful strokes through the water. In these habits, and in its colour-pattern, it is so exactly similar to the larva of *Hemicordulia australiæ*, that I have held a few of each in my hand, and have been quite unable to distinguish them, except by looking at the labium.

Altogether, therefore, the evidence of the early stages is *very strongly in favour* of the inclusion of *Cordulephya* in the *Eucordulina*.

ii. The Form of the Imago.—Under this heading, I take the study of the imago, *apart from wing-venation*. As might be expected, the evidence, in most respects, reinforces that of the early stages. The robust head and thorax, and the remarkably long legs of the nymph are repeated in the imago, and shew unmistakably the *Eucordulian* connection. In *Cordulephya*, however, we do *not* find the corduliform abdomen usually associated with the *Eucordulina.* In this respect, *Cordulephya* resembles the *Idocordulina.* It should be noted, however, that the abdomen of the larger species, *C. montana*, is not quite so cylindrical as that of *C. pygmæa;* so that the narrowing of the body may be merely concurrent with reduction in size.

iii. *The Wing-Venation.*—A study of the wing-venation of *Cordulephya* (Plate xii., figs. 1-6) seems to shew not the slightest resemblance to the *Eucordulina,* but, on the other hand, exhibits many close resemblances to the *Idocordulina.* The impression is, of course, mainly gathered from the region of the triangles. Prof. J. B. Needham* assumes that, in the ancestors of our *Anisoptera,* "fore and hind-wings were originally alike," and holds that *Cordulephya* is a genus that has perpetuated this zygopterous character. From this basis, he traces the development of the *Corduliinæ* by "differentiation of the fore and hind-wings, brought about by a number of minor shifts of parts, and chiefly by the broadening of the hind angle of the hind-wing and the development of an anal loop for its support." Now it is evident, since he takes *Cordulephya* as an illustration of his primitive wing-type, that he would have us infer, that the fore and hindwings of the ancestors of the present-day *Corduliinæ* were alike in being *narrow and of a zygopterous character*, and that the anal loop was a *cænogenetic development* in the *Libellulidæ.* Neither the fossil record nor the study of the wings themselves bears this out. The oldest fossils referable to the *Protodonata* are *not* zygopterous but anisopterous, though, as might have been expected, there is no triangle or other highly specialised part, such as we associate with present-day *Anisoptera.* The essential tendency, which, in our *Zygoptera,* resulted in enormous reduction of the basal areas, and so led to the *petiolate* wing, is not indicated in the earliest fossils.

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* Ann. Ent. Soc. America, I., 4, 1908.

Again, taking the evidence of the wings themselves, the forewings of our *Anisoptera* bear unmistakable evidences of greater reduction than the hindwings, in the greater amount of bending undergone by the triangle, which is evident in the *Corduliinæ*, but far more evident in most of the *Libellulinæ;* and also in the distinctly *compressed* or slanting arrangement of the cells along or near the posterior margin.

The point I desire to emphasise is, that *all* the characters of our present-day *Anisoptera were developed out of existing cell-material.* Needham himself admits it in everything *except* the anal loop, and he has treated the development of the triangles in a very masterly manner. If his treatment of *Corulephya* is correct, we must assume that a remarkable cænogenetic development of a whole host of anal cells in the hind-wing was begun, continued, and perfected during the development of the *Libellulidæ*, bringing about the principal differentiation between fore and hindwings. One has, however, only to look at the clear evidences of *stretching*, in a direction *across* the wing-length, undergone by the anal cells of any exceptionally broad-winged *Libellulid*, to see that the anal loop and the broad hindwing basal area is only a development of *cells that were always present there*, right back, through the aniso-zygopterid fossils, to the dawn of the order. Further back than that, we have evidence that many of the gigantic fossil insects of the Carboniferous age, which are now generally agreed to be the ancestors of our *Odonata* amongst other orders, possessed forewings that *overlapped* the hindwings. (See the figure of *Titanophasma fayoli* Brogniart in Sharp's "Cambridge Natural History of Insects," p. 276.)

I assume, therefore, contrary to Needham's hypothesis, that *a moderately broad basal area of the hindwing was originally present in the older Anisoptera, and that in this area there were a large number of unarranged cells, from which, by various degrees of rearrangement and readjustment, the different kinds of anal loops and supports now* *found in the Aeschnidæ and Libellulidæ took their rise.* As it is not the purpose of this paper to deal fully with this question, I will now proceed to consider the development of *Cordulephya* from this new standpoint.

The *Eucordulian* relationship of *Cordulephya* being so clearly indicated in its early stages, as well as by some of the imaginal characters, we have to seek an explanation of the remarkable character of the wing-venation, and its apparently *Idocordulian* connection, from the premises above stated. It is, I think, evident that *Cordulephya*, instead of being, as Needham supposed, an archaic and generalised form, is *a highly specialised and reduced* form, descended from the same ancestors as the rest of the *Eucordulina*, *after* that group had become differentiated from the *Idocordulina*. In that case, the resemblance in wing-venation to the *Idocordulina* is purely a *resemblance of convergence*, brought about by extreme reduction. I give the following reasons in support of this statement:—

A. *The absence of generally recognised archaic characters in the venation.*—Notice particularly the freedom from supernumerary cross-veins, the strong formation of the bridge with no supplementary bridge-crossveins, and the convergence of M_4 and Cu_1 in the forewing; also the arculus-sectors, which shew some tendency towards fusion.

B. *The remarkable flight and habits of the imago.*—These seem to me to point to a high degree of specialisation, brought about by a strenuous fight against adverse conditions.

C. *A comparison of the wing-venation of the two species C. pygmæa and C. montana.*—This is most important. First of all, throughout Australia, wherever mountain-forms are found, they are almost certainly more archaic than the allied coastal forms. The admittedly archaic types, such as *Telephlebia*, *Petalura*, *Austroaeschna*, *Synthemis*, and *Synlestes* are either entirely confined to the mountains, or shew greater specialisation in their coastal representatives. The explanation of this is simple, though it has not yet been worked out in detail. Along the coast, with its abundant rainfall and favourable conditions for *Odonate* life, the older indigenous *Odonata* of Australia have had to face a continuous invasion of new types. The main army of invaders passed into Australia *viâ* Torres Straits, and worked down along the Queensland coast into New South Wales, and even to Victoria. Besides these, evidence is accumulating that a smaller number crossed *viâ* Timor and Port Darwin, thence making eastward to reinforce the main stream of invaders in North Queensland. A few have worked down the North-Western coastline; about these little is known, but their effect on the autochthonous *Odonate* fauna of South-Western Australia has been *very small indeed*, compared with the effect of the main eastern invasion on those of Eastern Australia. Besides a large number of *Libellulinæ* (of which subfamily a very large majority of the recorded Australian species can be shewn to be invaders), we may instance *Anax* and *Hemianax*, *Macromia*, and a number of highly reduced and specialised *Cœnagrioninæ*.

Now wherever these invaders have come into competition with the older forms, the latter have either succumbed, or have retreated into the mountain-fastnesses, where the conditions are more in their favour, or have remained and competed with the invader; the result being, in the last case, that the invaded, and very often the invader also, have become modified in a direction of greater specialisation, and nearly always by *reduction*. Many instances of this could be given, but two will suffice. Taking the *Synthemina*, we have the three genera *Synthemis*, *Metathemis*, *and Choristhemis*, of which the first is the least specialised, the other two showing a distinct advance on it. Now, in Western Australia, we have *three* species of *Synthemis*, *none* of the other two genera. In Eastern Australia (excluding Tasmania), we have only four species of *Synthemis*, three being confined to the mountains; four species of *Metathemis* found on the mountains, and one on the coast also, but the mountain-form (*M. guttata*) is smaller than the corresponding coastal form (*M. guttata*, var. *pallida*); and finally two species of *Choristhemis*, both *coastal* forms only, and both distinctly more specialised than the other species. For the other example, I take *Synlestes weyersi*, a species that shews a remarkable gradation of venational forms. Specimens from the Blue Mountains are much larger and more densely reticulated than the coastal forms, and a series from different localities can be arranged to shew *progressive specialisation by reduction*, in a most perfect manner.

Comparing now the venation of *Cordulephya montana* and *C. pygmæa*, we see, at once, that the mountain-form (*C. montana*) is the *less reduced*. The point specially to be noticed here is, that all this evidence is in favour of the "quadrilateral" triangle of *Cordulephya* being "*not primitive, but secondarily derived from a three-sided one, and an extreme case of specialisation.*"* (I quote the very words used by Needham on the four-sided triangle of *Pentathemis*). We may suppose that the two closely allied species now existing were, in the near past, one single species, with a range probably including that of the two, or of even greater extent. It is, moreover, extremely probable that this species had a *completely* or *almost completely* recessed hindwing-triangle. One portion of this species, located in the mountains, was not faced with such a strenuous task as the other portion, that along the coast. The latter, left to fight the invaders on its own ground, and, as it were, being placed in the forefront of the conflict, had either to be exterminated, or to conserve its resources so as to make a successful fight. The line of defence adopted is a well-known one, and had already been carried out more completely amongst the *Odonata*, by practically the whole of the *Cœnagrioninæ; viz.*, defence by reduction, conservation of force and material, and alteration of habits. Being unable to compete with the invaders along the *Libellulid* line of development, *Cordulephya* began a *cænogenetic departure towards zygopterous lines.* This was confined to the imago, the larva being apparently well able to hold its own. This departure, aiming at reduction in size together with an alteration of habits of flight, necessitated a new line of development in wing-venation. The large triangles and anal area, so necessary to the soaring and skimming flight of *Libellulidæ*, were no longer of value, and, to whatever degree these may have been developed in *Cordulephya*, they had now to be undone and altered to the new requirements. There set in, therefore, the *opposite tendencies* to those associated with the *Libellulidæ* in general. Reduction in size meant *particularly* reduction in basal areas; as the hindwing became narrower, the anal loop (whether it was well-formed or not matters little here) became more and more reduced, until we see it represented now in *C. pygmæa* by two strong and well-formed cells; a *procession* instead of a *recession* of the hindwing-triangle began, accompanied by a reduction in actual size and an *ascent* of the upper cross-vein, re-forming the original "quadrilateral" triangle of the older *Libellulidæ*. In all this, *C. pygmæa* far outran *C. montana*, as would have been expected. In *C. montana*, we see an intermediate stage, which is very strong evidence in favour of our view of the case. The hindwing-triangle is much *wider* than in *C. pygmæa*, and much less recessed. It appears that the triangle has been stretched or widened along the wing-length by the gradual narrowing of the basal areas, but that the basal side has not yet reached a position of stable equilibrium. *C. pygmæa* has solved the problem by shortening the triangle, and supporting it by a second cubital cross-vein placed well after the arculus. The forewing-triangle of *C. montana* is also much larger and wider than that of *C. pygmæa*, and the ascent of the upper cross-vein is less, so that the triangle of the former is more normally shaped. As regards the anal loop, the reduction to three or four cells in *C. montana* shews us still a *well-defined anal loop*, especially in the female; from which we may infer that the original larger loop was also fairly well defined, as in other *Eucordulina.* Another interesting point is the reduction of the membranule. In *C. montana* ♀ it is still present in both wings; in *C. montana* ♂ it is absent from the forewing, and present, though much narrowed, in the hindwing. In *C. pygmæa*, both sexes, it is completely eliminated, being replaced in the hindwing by a small tuft of hairs (Plate xii., figs. 3-6). Finally, it should be noted that some of the parts under discussion are still variable, a long series of *C. pygmæa* shewing considerable differences in the position of the "break" of the costal side of the triangles. A few specimens have *normal* hindwing-triangles, and a nearly normal one in the forewing; but by far the greater number incline to the opposite extreme.

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* *Loc. cit.*, p.278.

D. *Comparison of the two species apart from venation.*—Two points here are worthy of note. Firstly, *C. montana* has the more *corduliform* abdomen of the two. This shews that the species, before reduction, may have had a typically *Eucordulian* abdomen. I do not think the original abdomen was broadly corduliform, but a very good idea of its probable appearance may be gathered by comparing the abdomens of the *Synthemina*; the form in *Synthemis* corresponding to the original form for *Cordulephya,* that of *Metathemis* being similar to that of *C. montana,* and that of *Choristhemis* similar to that of *C. pygmæa.* Secondly, in the females of the two species, the vulvar lamina is more reduced in *C. pygmæa,* leaving the underside of segment 9 widely open, so that larger egg-masses can be more easily exuded. Bearing in mind the extreme rapidity and timidity of the movements of the female during oviposition, the advantage of this to *C. pygmæa* is evident.

E. *The comparative sizes of the larvæ.*—Though the imagines of *C. pygmæa* and *C. montana* do not differ very greatly in size, yet the larva of the latter is remarkably large, both as compared with that of the former and with its own imago. In both species, the larvæ are large for the size of the imago. For instance, *Diplacodes haematodes* is a larger insect than *C. pygmæa;* the larva is, however, smaller. In the case of *C. montana*, it is hard to resist the conclusion that the imago must, at one time, have been a much larger insect. The reduction in size of the larvæ has not kept pace with that of the imagines, because the actual cænogenesis was confined to the *wings and abdomen* of the imagines only, (note the *Eucordulian* character of head, thorax and legs still remaining). This may also have been partly due to the existence of the two broods, which I have already explained. If the species were preserved by the complete sacrifice of one of two broods in the larval stage, there did not exist the further necessity for change that affected the imagines. But a certain amount of reduction of larval size must necessarily accompany the imaginal reduction; and this is still proceeding, without affecting the *Eucordulian* character of the larvæ.

iv. *A comparison of the two known Species of the Genus.*—This has already been discussed under headings C, D and E of iii., with a view to shewing that *Cordulephya* is specialised by reduction. The same argument is, of course, valid for its inclusion in the *Eucordulina*. It would, however, be greatly strengthened if we could point to one or more species that form intermediate links between *Cordulephya* and the main body of the *Eucordulina*. It would be too much to expect a complete series of forms linking the two together, but we might expect to find some Australian *Corduline*, as yet untouched by the main stream of invaders, which would give us an idea of what the ancestor of *Cordulephya* was like. Such a form, I venture to assert, may be seen in *Hesperocordulia berthoudi* Tillyard*, a rare species found in South-Western Australia.

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* "Further Notes on some rare Australian *Corduliinæ*" These Proceedings 1911, p.376.

Although this species is much larger than *Cordulephya*, its abdomen is scarcely more corduliform than that of *C. montana;* and it possesses a colour-pattern of thorax and abdomen which is remarkably similar to that of *Cordulephya*, the only difference being that the red of *Hesperocordulia* becomes dull orange in *Cordulephya.* If we consider the extreme peculiarity of the colour-pattern of these two insects, and that it is not even approached by any other known *Corduline*, we shall see that it constitutes a strong argument in favour of their close relationship. The ancestors of *Cordulephya*, before they came in contact with the eastern stream of invaders, must have been closely allied to *Hesperocordulia* as we find it now. Points of importance, here, in the wing-venation of *Hesperocordulia* are (i.) the fact that recession of the hindwing-triangle is not *absolutely* accomplished; (ii.) the fact that the anal loop has no apical extension; (iii.) the fact that the arculus-sectors are not fused. It is not necessary to suppose that the ancestor of *Cordulephya* had progressed even so far in a *Eucordulian* direction as *Hesperocordulia* now has. But even if it had, it would not yet have reached a *stable* position, for variation is still evident in that species. So much easier, therefore, would the start of the reduction-process be. Placing the wings of *Hesperocordulia berthoudi*, *Cordulephya montana* and *C. pygmæa* in order, side by side, we see

(i.) Three consecutive stages in the reduction of the triangles, by procession from the arculus and the ascent of the upper cross-vein.

(ii.) Three consecutive stages in the reduction of the anal loop, from ten cells to four or three, and then to two strong cells only.

(iii.) A tendency to strengthen the arculus by the beginnings of a fusion between the sectors.

I have already discussed* the connection of *Hesperocordulia* with the *Eucordulina*, and have given reasons why it should be included in that group. We see, therefore, how it forms the connecting link between them and *Cordulephya.*

Reviewing the above evidence *in toto*, I conclude, (i.) that a *Eucordulian* connection for *Cordulephya* is proved; (ii.) that its apparently *Idocordulian* relationship in wing-venation is due to convergence by reduction; (iii.) that the *Eucordulian* connection is strong enough to justify us in including it in that group, rather than placing it in a separate group of its own.

NOTE A.—ON THE REDUCTION-PROCESS EXHIBITED BY CORDULEPHYA.—The important part played by cænogenetic reduction in the formation of our present-day *Odonata* has been hitherto ignored, though there can be no doubt that it has played a far more effective part than any other form of specialisation. The result of ignoring it has been that a highly erroneous view of the phylogeny of the families of the *Odonata* is growing up. When their life-histories come to be written, I venture to state that such forms as many of the *Protoneura* (including *Selysioneura*, claimed by Foërster to be one of the most promitive of *Odonate* types), *Hemiphlebia*, *Nannophya*, *Agrionoptera*, and many others in which reduction can be traced, will be found to be *highly specialised by reduction*, and not truly archaic by comparison with other existing forms. We are so especially apt to think of Australia as the home of archaic forms, that we forget that Europe and Asia possess forms equally archaic. (*Cordulegaster* and *Palæophlebia* are probably as old as any now existing). We must not argue by analogy from the distribution of the higher animals, for the *Odonata* are a very ancient order, and reached a high degree of development long before Australia was as isolated as it now is. Nor have the higher animals in Australia been subjected, in the same degree, to the strenuous competition with immigrants that the autochthonous Odonata have had to undergo.

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* *Loc. cit.*, p.381.

As the *reduction-process along a new line of development*, which has been the main factor in evolving *Cordulephya*, is of the greatest importance, I propose the term *asthenogenesis* (Gr. ἀσθενὴς, weak) for it, in contrast to specialisation in development of parts to form *stronger* types, such as has been the main line of development of the *Libellulidæ*. The latter may be termed *menogenesis* (Gr. μένος, strength). Thus, we should say that the *Anisoptera* as a whole are the *menogenetic* group, the *Zygoptera* the *asthenogenetic* group of *Odonata*. A race may follow a menogenetic line of development up to a certain standard, and then, like *Cordulephya*, adopt an asthenogenetic line. It is, of course, possible, though less likely, for the opposite to happen.

NOTE B.—ON THE "QUADRILATERAL" GENERA OF THE LIBELLULIDÆ.—It seems very open to doubt whether the four-sided triangle, at present found in some of the *Libellulid* genera, is in any case an archaic structure. It should be borne in mind that the *Anisopterid* triangle was formed at a period of intense energy and development amongst the *Odonata*, when the group probably occupied a far more dominant position amongst the *Insecta* than it does now. That being so, races that remained half-way, adopting neither the *anisopterous* nor the *zygopterous* tendency in full, must very soon have become extinct. The present-day "quadrilateral" *Libellulidæ* are all (except *Pentathemis*, an admittedly specialised form) small species in comparison with their nearest related forms. That being so, it is important to enquire how far asthenogenesis has affected them. If the larvæ are found to be highly developed, and the imagines, apart from the triangles, shew a general absence of archaic characters, the balance of evidence is surely in favour of their being *asthenogenetic* members of the more highly specialised groups. In this connection, I suggest a comparison of the two species, *Nannophya(Nannodythemis) dalei* and *N. australis*, with *Cordulephya montana* and *C. pygmæa*. Exactly the same forces have been at work on the two species, and the relative states of the triangles and surrounding areas in the two pairs are remarkably similar. But *Nannophya* has not attained the splendid zig-zag flight of *Cordulephya*, owing to the persistence of the broader anal area of the hindwing. In *Nannophlebia* and *Tetrathemis*, however, the flight is very similar to that of *Cordulephya*, the basal areas being more reduced.

As regards *Neophya* and *Austrophya*, neither of these can now be claimed as being closely allied to *Cordulephya*. *Austrophya* is clearly an asthenogenetic member of the *Idocordulina*, possessing all the characeristics of that group. *Neophya* seems to me much more open to doubt. We should be content to await the discovery of its larva before pronouncing a judgment; but it is quite possible that some other African genus exists, which will connect it to a main group in the same way that *Hesperocordulia* connects *Cordulephya* to the *Eucordulina*.

EXPLANATION OF PLATES XI.-XII.

Plate xi.

Fig.1.—Full-fed nymph of *Cordulephya montana*, n.sp.(× 4).
Fig.2.—Labium of same (× 11).
Fig.3.—Outline of labium of nymph of *Cordulephya pygmæa* Selys (× 22).
Fig.4.—Head of same, showing labium in position of rest (× 4).
Fig.5.—Gizzard of same, showing chitinous folds with teeth (× 20).
Fig.6.—Ovum of *Cordulephya pygmæa* Selys (× 45).

Plate xii.

Fig.1.—*Cordulephya pygmæa* Selys, ♂(× 2½).
Fig.2.—*Cordulephya montana*, n.sp.,♂(× 2½).
Fig.3.—Venation of basal portion of wings of *C. pygmæa*,♀(× 5).
h=basal tuft of hairs.

Fig. 4.—Venation of basal portion of wings of *C pygmæa*, ♂ (× 5).
h = basal tuft of hairs.

Fig. 5.—Venation of basal portion of wings of *C. montana*, ♂ (× 5).
m = membranule.

Fig. 6.—Venation of basal portion of wings of *C. montana*, ♀ (× 5).
m = membranule.

Fig. 7.—Appendages of *C. pygmæa*, ♂, dorsal view (× 10).

Fig. 8.— ,, ,, ,, profile view (× 10).

Fig. 9.—Appendages of *C. montana*, ♂, dorsal view (× 10).

Fig. 10.— ,, ,, ,, profile view (× 10).

Fig. 11.—Underside of segments 8-10 of *C. pygmæa*, ♀ (× 10).

Fig. 12.— ,, ,, ,, ,, of *C. montana*, ♀ (× 10).

Fig. 13.—Outline of inferior appendage of *C. pygmæa*, ♂, sketched from below (× 10).

Fig. 14.—Outline of inferior appendage of *C. montana*, ♀, sketched from below (× 10).

Fig. 15.—Tibia and tarsus of foreleg of *C. pygmæa* ♂ (× 5).
(The tibial lamella is on the underside, and cannot be seen).

[Printed off 16th November, 1911.]

ORDINARY MONTHLY MEETING.

August 30th, 1911.

Mr. W. W. Froggatt, F.L.S., President, in the Chair.

Mr. F. M. Clements, M.P.S., Stanmore, was elected an Ordinary Member of the Society.

The Donations and Exchanges received since the previous Monthly Meeting (26th July, 1911), amounting to 20 Vols., 97 Parts or Nos., 26 Bulletins, 2 Reports, 6 Pamphlets, and 1 Map, received from 57 Societies, &c., and one Individual, were laid upon the table.

NOTES AND EXHIBITS.

By permission of the Curator of the Australian Museum, Mr. A. R. McCulloch exhibited representatives of six species of fishes collected at Murray Island, Torres Strait—*Glyphisodon zonatus* Cuv. & Val., *Stethojulis axillaris* Quoy & Gaim., *Platyglossus notopsis* K. & v.Hass., *Rhinogobius neophytus* Gunth., *Oxymonacanthus longirostris* Bl. & Schn., and *Canthigaster valentini* Bleek.,(*C. cinctus* Rich.?). All are well known species from the Indian and Pacific Oceans, but do not apppear to have been recorded from Australia.

Mr. Fred. Turner exhibited and offered observations on *Poa saxicola* R. Br., which was collected, with numerous other grasses and forage plants on the "Snow-Leases" on the Australian Alps, by Mr. R. H. Gowland who forwarded them to the exhibitor for identification. So far as he was aware, this was the second specimen only that had been collected on the Australian continent; the first having been recorded by him in the Society's Proceedings for 1893. *Poa saxicola* may be regarded as the rarest Australian grass. It was first found on Mount Wellington, Tasmania.

Mr. Turner also showed a number of interesting grasses indigenous to North Australia, forming part of a collection of forage plants and grasses, which had been received by him for identification and report as to their economic value for stock-feed. They were: *Andropogon sericeus* R. Br., var. *polystachyus; Anthistiria frondosa* R. Br; *Centotheca lappacea* Desv., probably a new record for this species; *Chloris scariosa* F.v M., said to be the most beautiful grass in the north; *Eriachne ciliata* R Br.; *E pallescens* R. Br., probably a new record for this species; *E squarrosa* R. Br.; *Heterachne Brownii* Benth.; *Panicum argenteum* R. Br.; *Panicum Petiveri* Trin., (in the Flora Austr., vii., p.481, this grass is queried as a variety of *Panicum foliosum* R. Br., but Trinius' name deserves to be restored to this plant as it appears to be a good species); *Panicum trichoides* Sw.; *Pollinia articulata* Trin.; *Rottbœllia exaltata* Linn.; and *Sorghum intrans* F.v.M.

Mr. A. A. Hamilton communicated a Note on the correct identification of a grass exhibited at the Meeting in May, under the name of *Panicum glabrum* Gaud., but which, he contended, was *Digitaria didactyla* Willd. As the specimens in question were subsequently sent to England for determination, and were not at present available for comparison, the point at issue remains undecided.

Mr. Cheel exhibited specimens of *Digitaria didactyla* Willd., (*Panicum didactylum* Kunth) to be found plentifully at Parsley Bay. The specimens were determined by Dr. Otto Stapf, who says that the species was collected by F. W. Sieber at Port Jackson, or in the neighbourhood, as long ago as 1823, and distributed by him in his "Agrostotheca," No.72. It has since been found on one of the lawns in the Botanical Gardens(E. Cheel; January, 1903); Watson's Bay(O. A. White; October, 1910); and at Bondi (W. F. Blakely; November, 1910).

Dr. J. B. Cleland exhibited specimens of adults and larvæ of *Culex australis* Erichs., (*C. crucians* Walk.). These had been identified, through Mr. E. E. Austen, by Mr. Edwards, of the British Museum. The larvæ, from which some of the adults were hatched out, were found in shallow pools of water near the summit of Mount Kosciusko at a height of 6,000 feet in December, 1910. The pools were formed by the melting of patches of snow, which formed parts of their boundaries. Their shallowness would allow, during the day-time, of sufficient warmth from the sun to enable development to proceed. Adults were found, biting during the day-time, amongst trees at a lower level (about 5,000 feet) near the Hotel Kosciusko. This species, which is one of the earliest Australian forms recorded, seems previously to have been taken only in Tasmania, and at Marysville, Victoria. It will be interesting to ascertain whether its habitat is restricted to high and cold districts. Its occurrence in Tasmania and at Kosciusko is of considerable interest, being another of the links connecting the faunas of these parts. Dr. Cleland also showed an aboriginal stone axe-head, picked up amongst the remains of kitchen middens and fragments of aboriginal bones on the slopes of a sandhill overlooking the northern end of Cronulla Beach, within three miles of Captain Cook's first landing-place in Botany Bay. He also mentioned that, at the end of June, he had met with a white-bellied Sea-eagle (*Haliaëtus leucogaster* Gm.) dwelling so close to Sydney as an unfrequented arm of Middle Harbour. Here it had its massive nest in a large tree about 30 feet from the ground on a hill-slope covered with trees and shrubs. From its attentions to the neighbourhood of the nest, this structure was probably then in use.

Mr. A. S. Le Souëf showed the skin of a very dark specimen of the Vulpine Phalanger (*Trichosurus vulpecula*) from Yallup, W.A., [per favour of the Director of the Perth Museum and Art Gallery]. The hair on the back is long, and silky and black; under fur grey, the breast white. *T. vulpecula* seems to vary more in West Australia than in the East, where melanism is very infrequent, although general in *T. caninus*.

Dr. Petrie (for Dr. Chapman) showed a Posidonia fibre-ball picked up on Balmoral Beach; and he reported that the beaches round Middle Harbour were strewn with Posidonia after the S.E. gale of last week.

Dr. D'Ombrain exhibited some remarkable undetermined chrysalides encased in leaves, from Springwood; and also the eggs of an undetermined insect.

DESCRIPTIONS OF NEW SPECIES OF AUSTRALIAN COLEOPTERA.

By Arthur M. Lea.

Part IX.

(Plate xvii.)

Family STAPHYLINIDÆ.

Œdichirus geniculatus, n.sp.

Head, prothorax, and mesosternum red; elytra, abdomen, and metasternum black; appendages (knees infuscated) flavous. With rather stiff scattered setæ or hairs.

Head somewhat wider than long, gently convex, with fairly large, scattered punctures. Antennæ thin, extending almost to tip of elytra. *Prothorax* slightly longer than wide, slightly wider than head, widest at about the apical fourth, thence oblique to near base, which is rounded; with moderately numerous distinct punctures, most of which are in irregular longitudinal series. *Elytra* shorter and narrower than prothorax, sides rounded, apex incurved to middle; with punctures the size of those on prothorax, but more evenly distributed. *Abdomen* long, and tipped with two acute spines; four basal segments with dense and coarse punctures, except at their tips, the two apical segments with smaller punctures. *Legs* rather long, front tarsi strongly inflated. Length 7, to apex of elytra 2½ mm.

Hab.—Victoria: Timboon(H. W. Davey).

Close to *Œ. rubricollis*, and *Œ. tricolor*; from the former, distinguished by its much paler legs and red head; and, from the latter (to which it is closer), by its black elytra.

Scopæus rotundicollis Macl.(now Sunius).

I have recently examined the type of this species. It is a *Sunius*, close to *S. brevicollis*, but slightly smaller, and with the markings on the elytra of one specimen confined to the basal third; and, on the other, to the basal two-thirds; the antennæ are also shorter. The punctures on both head and prothorax are of the characteristic form of those of *Sunius*.

Family PSELAPHIDÆ.

The late Rev. R. L. King's Collection was allowed to get into extremely poor condition before it was acquired by the Australian Museum, but the *Pselaphidæ* and *Scydmænidæ* fortunately escaped destruction, a fate that befell some of his types in other families.

In Sydney, recently (September, 1910), I examined his types of *Pselaphidæ*, as well as those of Macleay's from Gayndah. The types of all their species are there, with the following exceptions.

TYRUS VICTORIÆ King (now PALIMBOLUS).

Described from Castelnau's Collection, and probably never retained by King. The species supposed to be this, was described by Raffray as a *Didimoprora*, and consequently is now referred to *Palimbolus*. It is not represented at all in the King Collection.

BRYAXIS INSIGNIS King (now RYBAXIS).

This species is represented in the Australian Museum by two Tweed River specimens, that were apparently taken by myself, and were certainly never seen by King. The species, however, is the same as the one identified by Raffray.

EUPLECTUS EXCISUS King (now EUPLECTOPS).

The specimen in the Howitt Collection, redescribed in Proc. Roy. Soc. Victoria, 1910, p.13, as the type or a cotype of this species, appears to be really the type. There is, in the King Collection, a specimen labelled "Euplectus excisus R.L.K.(?)" but it is from Cape Schank, and does not agree well with the original description.

TYRUS HOWITTI King (now TYROMORPHUS).

RYTUS VICTORIÆ King.

BRYAXIS ATRA King (now EUPINES).

BYTHINUS NIGER King (now EUPINES).

The types of these species are in the Howitt Collection, and are not represented at all in King's.

In addition to the specimens mounted on cardboard, there are numerous others mounted as slides for the microscope, with the names scratched on the glass.

Many of the carded specimens were extremely dirty; I obtained permission to float off and clean some of these, and note of them as follows :—

TYCHUS OBLIQUUS King (now EUPINES).

The types are males. The abdomen has a small tubercle near the apex of the second segment on the under-surface. The legs, at least the four hind ones, are unarmed, but I was unable to examine the front ones very clearly on either specimen. The tenth joint is very curious, being placed obliquely to the rest of the antennæ. There is also a male mounted as a slide. The species is omitted from Raffray's recent monograph in Wytsman's "Genera Insectorum."

EUPINES VICTORIÆ King.

The types are females. They appear to be partly dark specimens of *Eupines polita* King (*Bryaxis* of King), judged by the types of that species, and they agree in all details with female specimens in my collection, identified as *E. polita* by Raffray.

EUPINES GEMINATA King.

There are two specimens in the Collection, one certainly female, the other probably so; but, on being floated off, its under-surface was so dirty, that it could not be carefully scrutinised, and the legs were so huddled together that they could not be examined for armature.

RYTUS CORNIGER King.

In general appearance very close to *R. Kingi*, but much paler, and with the elytral punctures smaller; it is also more sparsely clothed.

BATRISUS CYCLOPS King (now BATRISODES).

Bryaxis hirta Macl.

The types of these were compared side by side, and found to be identical. King's is the older name. Raffray (Proc. Linn.

Soc. N. S. Wales, 1900, p. 137, Pl. x., fig. 28), described and figured as *B. cyclops*, a species, from the type of *R. giraffa*, which he supposed to be identical with *B. cyclops;* but, in this, he was evidently mistaken, as *B. cyclops* is a distinct species. The species he doubtfully described as *B. hirta* (p. 139) was correctly identified.

BATRISUS ELIZABETHÆ King (now BATRISODES).

A small, pale species, base of abdomen on upper surface with three impressions occupying almost the entire width, the median one as wide as the others conjoined. The dorsal stria on each elytron is strong, and continued to well beyond the middle. The legs are apparently unarmed, and the type is evidently a female.

BATRISUS CONSPICUUS King (now MESOPLATUS).

Mesoplatus Mastersi Raffr.

There are two female specimens standing under this name in the King Collection, although but one was known to King when the species was described. Raffray subsequently described the species as *Mesoplatus Mastersi*; both he and King referred to its resemblance to *M. barbatus*.

BATRISUS NOBILIS King (now TYROMORPHUS).

In Proc. Roy. Soc. Vic. 1910, p. 149, with some slight doubt I identified a Batrisodes as belonging to this species; but the type of *B. nobilis* is not even near *Batrisodes*, as its abdomen is strongly margined. Its legs are unarmed, but as the under-surface of its abdomen is feebly, longitudinally impressed, it is possibly a male. The head is shallowly, longitudinally impressed, the impression at its hind end being marked by two foveæ. The prothorax has a biarcuate impression near the base. The dorsal stria on each elytron is represented by a small basal fovea, behind which is a very faint longitudinal impression. There are fairly distinct punctures on the whole of the upper surface.

A second specimen is in the Macleay Museum, from Rope's Creek. I did not examine the palpi of the type, having compared it with the Rope's Creek specimen, and intending to look at those of the latter very carefully. The latter specimen, however, has one palpus entirely, and the other partly missing. It is impossible, therefore, to be sure as to its genus, but it appears to belong to *Tyromorphus.*

FARONUS PUNCTATUS King (now SOMATIPION).

Somatipion globulifer Schfs.

There are two King George's Sound specimens in the Macleay Museum, that agree well with the description and Raffray's figure of *Somatipion globulifer;* they also agree with the type of *Faronus punctatus.* The remarkable median line on the upper surface of the abdomen is quite as distinct on King's type as on any other of the numerous specimens before me, but no mention of it was made by King.

BRYAXIS ÆQUATA King (now EUPINES).

Eupinoda diversicornis Raffr.

There are five female specimens standing under the name of *æquata* in the King Collection. In the Macleay Museum, there is a specimen from Elizabeth Bay, labelled as the male of *B. æquata,* and the ninth joint of the antennæ is as described. This specimen agrees with others in my collection, identified by Raffray as his *Eupinoda diversicornis,* and it agrees well with his description and figure of the antennæ. In his recent monograph, the species is transferred to *Eupines.*

RYTUS EMARGINATUS King.

On the card bearing the presumable types of this species, there are four specimens. One is a male, and agrees with the description; in general appearance it is extremely close to *R. Kingi,* but its cephalic structure is not quite the same, and its punctures are finer. Two of the others are females of the species, but the fourth specimen belongs to *Batraxis Armitagei.*

SAGOLA AUSTRALIÆ, n.sp.

♀. Reddish-castaneous, head and pronotum somewhat darker than elsewhere. Moderately clothed with rather long, yellowish pubescence.

Head transverse; with two rather large interocular foveæ; in front with two wide antennary ridges, separated by a narrow and rather deep impression. Antennæ extending to about basal third of elytra, of almost even width throughout. *Prothorax* slightly wider than head, and slightly wider than long, widest near apex, thence oblique to base; with a large, deep, median fovea near base, sides near base foveate. *Elytra* at base slightly wider than widest part of prothorax, sides gently increasing in width to near apex; each with a strong subsutural stria marked by several small but deep impressions near base, dorsal stria represented by a deep subbasal fovea, and a short groove not quite extending to middle. *Abdomen* large, strongly margined, sides dilated to beyond the middle, apex pointed. *Legs* not very long. Length 2¼-2⅛ mm.

Hab.—New South Wales (Macleay Museum).

I have described the four specimens before me, although they are all females, as the genus is an interesting one, and is now *first recorded from the mainland. The species is readily distinguished from *S. Tasmaniæ*, by its very different elytral impressions.

BATRISODES SCULPTICOLLIS, n.sp.

♂. Flavous. With rather long, sparse, pale hairs.

Head slightly convex, a shallow median line from base almost to middle; a deep groove on each side of middle, starting level with the eye, and opening out near antennæ, so that the antennary ridge is very distinct; punctures sparse and rather indistinct. *Prothorax* widest at about apical third, where the width is about equal to the length, each side in front with a small punctate space; disc strongly elevated along middle, and then abruptly cut away and irregular, the apex strongly elevated; towards each side with a curved impression, commencing near the base in a fovea, another fovea in the middle connected with the lateral ones; and several small basal foveæ; without conical tubercles towards base. *Elytra* rather short, with a fairly large impression between each side and suture, from which a dorsal stria can be traced almost to middle; shoulders unarmed; punctures sparse and rather indistinct. *Abdomen* on upper surface with feeble tubercles somewhat obscuring the basal impressions; lower surface feebly flattened along middle. *Legs* rather long and apparently unarmed. Length, 2mm.

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* There are specimens of the genus from Mount Kosciusko in the Australian Museum.

Hab.—N. S. Wales: Blue Mountains (E. W. Ferguson).

The punctate latero-frontal spaces of the prothorax are much as in *B. apicicollis*, but that segment, from the side, appears to have two deep notches in front, the notches leaving a strong, blunt, sublaminate projection in front, and an acute projection between the front and middle (from certain directions, two acute projections can be seen). From directly in front it appears to be triangularly elevated at apex, then with two small acute elevations, and then with the middle strongly raised and feebly notched. The prothorax of *B. insignicollis*, when viewed from the side, appears somewhat similar; but the notches are not so deep, it has no acute elevations, and the frontal one is much smaller and less prominent; from directly in front it appears very different.

From some directions, the medio-lateral grooves of the head appear to be regularly and deeply cut; but, from others, each appears foveate at its base, with a narrow groove opening out in front. On the type, only six joints of each antenna are left; they are rather thin, the second joint as long as the first (but, from some directions, appearing decidedly longer), and the fifth slightly longer than the fourth or sixth. I have described the specimen, however, as the sculpture of the prothorax is very peculiar.

BATRISODES LATICOLLIS, n.sp.

♂. Flavous. With rather long pale hairs.

Head rather convex, and with a feeble median carina; near each eye with a round fovea opening out in front; antennary ridges very conspicuous; punctures rather indistinct. Antennæ long and rather thin, second joint(as viewed from the side) distinctly shorter than first, third and fourth shortest of all, seventh slightly longer than sixth or eighth, ninth and tenth each almost as long as seventh and eighth combined, eleventh longer and wider. *Prothorax* decidedly transverse, suddenly inflated at apical third, the inflated space rather densely punctate; from middle of disc, which is notched, to apex irregularly sculptured; towards each side with a distinctly impressed line, commencing near the base in a fovea, an irregular subbasal median fovea connected with the lateral ones, its sides marked by two feeble tubercles; at extreme base with a few small foveæ. *Elytra* about as long as wide; shoulders oblique, and scarcely armed; dorsal striæ not traceable to middle, but towards base very distinct; punctures sparse and small. *Abdomen* with a few feeble tubercles obscuring the impressions at base of upper surface; flattened along middle of under-surface, apex with a small fovea. *Legs* long and apparently unarmed. Length 2 (vix) mm.

Hab.—New South Wales (type in Macleay Museum).

The apex of the prothorax, at a glance, seems somewhat as in *B apicicollis*, but is essentially different; the prothorax itself is decidedly wider, the punctate latero-frontal spaces are less convex and less rounded; the elytra are shorter, with rather more distinct punctures, and with more deeply impressed striæ. There is also a considerable difference in colour, although this may be individual rather than specific. At first, it almost appears to be a small pale form of *B. gibbicollis*, but the prothorax of that species, when viewed from behind, appears to have a deep basal fovea, in front of which is an elevated ridge that terminates (at the notch) in advance of the punctate spaces. In the present species, the surface in front of the foveæ, although convex, does not appear to be ridged, and the notch (when viewed from behind) appears to be behind the punctate spaces. The excavated parts at the apex are also not quite the same, although partly obscured by clothing in both species.

BATRISODES MACROCEPHALUS, n.sp.

♂. Dark castaneous, appendages somewhat paler. With comparatively short, depressed clothing.

Head large, strongly convex; with a large, deep, irregular fovea close to base on each side of middle; densely and coarsely punctate. Antennæ, for the genus, not very thin, ninth and tenth joints each about as long as wide. *Prothorax* moderately transverse, about as wide as head across eyes; apex narrow, then sides strongly rounded to middle, and thence (commencing at a small spine) strongly coarctate to base, two narrow carinæ marking off a very narrow median line, which commences in a subbasal fovea; sides irregularly foveate; between middle and each side with two narrow carinæ, commencing near the base (where they are conjoined) in a small but very acute tubercle or spine; with distinct punctures. *Elytra* convex, about as long as wide, shoulders oblique, and each with a feeble tubercle, dorsal striæ traceable only at about basal fourth; with fairly numerous, clearly defined punctures. *Abdomen* with rather small but distinct punctures, base of upper surface with the lateral impressions wide, and the median very small; under-surface feebly concave along middle, the apical segment with a wide shallow impression. *Legs* not very thin; four front tibiæ thickened about middle; the hind pair longest, somewhat curved, and thickened towards apex; middle trochanters each with a small acute tooth, the hind ones each with a small strongly curved tooth. Length 1¾-2 mm.

♀. Differs in having the head smaller and less convex, the foveæ much smaller and disconnected, the shoulders less prominent, under-surface of abdomen gently convex along middle, and legs unarmed.

Hab.—Queensland: Wide Bay and Gayndah (Macleay Museum).

The head of the male is unusually large and convex for the genus; the two large, basal foveæ are feebly connected across the middle. The teeth of the hind trochanters, although hook-like, and very distinct from some directions, are usually difficult to see, especially on old and dirty specimens.

BATRISODES BIFOVEICEPS, n.sp.

♂. Reddish-castaneous, appendages slightly paler. Moderately clothed with comparatively short, suberect pubescence.

Head moderately large; with two very large, deep, irregular foveæ, separated by a strong ridge, which is transversely impressed near its base; punctures of moderate size, and rather numerous. Antennæ, for the genus, not very thin. *Prothorax* feebly transverse, sides increasing in width from apex to middle, where there is a feeble tubercle, thence coarctate to base; a carina along middle almost from base to apex, narrowly impressed along its middle; on each side of middle, near base, with a small acute tubercle or spine, marking the starting point of two slightly diverging carinæ; each side of base with a fovea, marking the end of a lateral impression, the foveæ not connected with the median one, which is very small. *Elytra* much as in the preceding species, except that the punctures are rather smaller. *Abdomen* as in the preceding species, except that the punctures are much less distinct. *Legs* rather stout; four hind trochanters with small, acute teeth. Length 1¾-2 mm.

♀. Differs in having the head smaller; the foveæ much smaller, shallower, and disconnected; a feeble carina between them; abdomen moderately convex along middle of under-surface, and legs unarmed.

Hab.—Queensland: Brisbane (Macleay Museum).

Allied to the preceding species, but the head of the male not quite so large or convex, and the punctures sparser and considerably smaller. The foveæ are considerably larger, more open, less basal, and of a different shape. From some directions, the head appears to have a large, median, elongated tubercle. The median carina of the prothorax, from some directions, appears solid; but, from others, an impressed line can be traced down its middle. The teeth of the hind trochanters are rather short, subtriangular, and not at all curved.

BATRISODES RUGICORNIS Raffr.

Including a co-type, there are now before me (from Glen Innes, Murrurundi, and Hunter River, in New South Wales; and Dalveen in Queensland) 37 specimens of this species; but, as they all have the hind trochanters with a long curved tooth, they are doubtless all males. I have seen no specimens that can be confidently identified as females.

BATRISODES HAMATUS King.

There are before me, eleven specimens of this species; eight are reddish-castaneous, but three are flavous, and agree exactly in sculpture with the darker ones. The female differs from the male in being slightly larger, and more robust; the under-surface of abdomen more convex, and the trochanters unarmed.

BATRISOCENUS TIBIALIS King.

The female of this species differs from the male in having all the trochanters unarmed, the front tibiæ simple, the under-surface of abdomen more regularly convex, and the head less convex along middle.

EUPINES FLAVOTERMINALIS, n.sp.

♂. Of a dingy piceous-brown, legs somewhat paler, head black, apical joint of antennæ flavous. Almost quite glabrous.

Head rather small, with two very feeble impressions in front. Antennæ rather long and thin, ninth joint rather small but distinctly larger than eighth, and about one-half the size of tenth, eleventh ovate. *Prothorax* moderately transverse, widest slightly in advance of middle, the sides thence oblique to base. *Elytra* rather large, sides rounded and dilated from base to near apex, sutural stria distinct, the dorsal entirely absent. *Abdomen* very feebly margined on upper surface, lower with a small tubercle towards apex of second segment. *Metasternum* with a very wide and rather shallow depression. Front and hind *tibiæ* shallowly notched towards apex. Length 1¼ mm.

Hab.—Tasmania: Latrobe, in flood-débris(A. M. Lea).

In general appearance, remarkably close to *E. inermis*, but slightly larger, tenth joint of antennæ conspicuously darker than eleventh, metasteruum darker, and with a much wider impression, and tibiæ different.

EUPINES ALCYONE, n.sp.

♂. Castaneous; elytra (except suture), sterna, and appendages somewhat paler than the other parts. With very short, sparse, adpressed pubescence, denser (but still sparse) on abdomen than elsewhere.

Head moderately large, with a small, round, deep fovea close to each eye, and with two shallow impressions in front. Antennæ not very long, ninth joint lightly, the tenth strongly transverse, eleventh briefly ovate. *Prothorax* distinctly transverse, widest close to apex, the sides thence subcoarctate to base. *Elytra* scarcely as long as wide; subsutural stria very feeble, the dorsal represented by a feeble basal impression; with small and rather sparse but distinct punctures. *Metasternum* widely and shallowly impressed. *Abdomen* with two small swellings at apex of second segment on under-surface. *Legs* apparently unarmed. Length 1¼ mm.

Hab.—Queensland: Townsville (H. H. D. Griffith, from F. P. Dodd).

In general appearance like a very small *Tyromorphus*. The elytral pubescence is extremely short; but, in certain lights, quite distinct; the subsutural stria on each elytron is so extremely faint, that it might quite fairly be regarded as absent.

EUPINES INNUBIS, n.sp.

♂. Bright castaneous. Abdomen sparsely pubescent, elsewhere almost or quite glabrous.

Head rather small, with a small fovea close to each eye, and with two feeble impressions in front. Antennæ rather long, fifth joint slightly inflated, ninth strongly transverse but no longer than eighth; tenth large, its apex produced on one side; eleventh considerably larger than tenth, briefly and irregularly ovate. *Prothorax* moderately transverse, widest close to apex, thence the sides coarctate to base. *Elytra* slightly wider than long, sides increasing in width from base almost to apex; subsutural stria distinct, the dorsal entirely absent; with a few rather indistinct punctures. *Metasternum* rather narrowly impressed along middle. Under-surface of *abdomen* feebly flattened along middle, apical segment very shallowly impressed. *Legs* rather long and apparently unarmed. Length, 1 mm.

♀. Differs in having the head slightly smaller; the tenth joint of antennæ much smaller, transverse, and of regular shape; the eleventh smaller, and inserted on middle of tenth; and the legs somewhat shorter.

Hab.—New South Wales: Sydney (Macleay Museum).

In general appearance, close to *E. aurora*, *E. litoralis*, *E. clavatula*, *E. capitata*, and the pale form of *E. polita*, but readily distinguished therefrom by the tenth joint of the antennæ of the male; the tenth seems to be separated from the eleventh by a short additional joint, so that it appears to be really the ninth, but the supposititious joint is really a small produced part of the tenth itself. The fifth joint, although decidedly larger than the fourth or sixth, is not large enough to entitle the species to be placed with such others as *E. nigricollis* and *E. globulifer*, &c.

From some directions, the second segment of abdomen of the male, on its undersurface, appears to have a very minute granule about its middle, but it is invisible from most directions.

EUPINES (BYRAXIS) IMPLUMIS, n.sp.

♂. Of a rather dingy pale castaneous. Almost glabrous.

Head transverse; with two very shallow impressions in front. Antennæ not very long; ninth joint larger, produced to one side, and the tenth placed on that side instead of at its middle; tenth ovate, scarcely larger than ninth. *Prothorax* lightly transverse, widest towards apex, thence the sides sub-oblique towards base. *Elytra* rather more convex than usual, about as long as wide; subsutural stria feeble, the dorsal absent. *Metasternum* deeply impressed along middle, the impression dilated to apex. Under-surface of *abdomen* with two tubercles at apex of second segment, the space between depressed, apical segment with a shallow fovea. *Legs* rather long, and apparently unarmed. Length, 1 mm.

Hab.—Queensland: Cairns (E. W. Ferguson).

Apparently allied to *E. melanocephala*, but smaller and of uniform colour. The ninth joint of the antennæ is somewhat as in *E. obliqua*, although not quite the same, but the fifth joint and the abdomen are very different. The ninth joint will readily distinguish the species from all others of the genus. The subsutural stria, on each elytron, is fairly distinct at the tip, but elsewhere is almost or quite invisible. Dr. Ferguson sent three males for examination, but no females. The antennæ are composed of but ten joints (I have examined them carefully, both from above and below), which associates the species with *E. Elizabethæ* in the subgenus *Byraxis*, a species it resembles to a certain extent, but differs essentially from in the club.

EUPINES CONCOLOR Sharp.

There are, before me, three specimens from Victoria, and five from South Australia, that appear to belong to this species. Sharp described the second ventral segment as having a small tubercle at its apex; the males now under examination have a small tubercle, but it is not at the extreme tip of the segment (as in several other species having the second segment tuberculate or fasciculate), but at about one-fourth from the tip.

The female (unknown to both Sharp and Raffray) differs from the male in having the tenth joint of the antennæ much smaller, the abdomen convex and non-tuberculate on its under-surface, and the metasternum with a smaller and shallower depression.

Var. ADELAIDENSIS, n. var.—Mr. H. H. D. Griffith has sent numerous specimens from Adelaide, that appear to represent a variety of this species. They agree exactly in all structural details with the typical form, but differ in having the head and basal two-thirds of abdomen (both surfaces) varying from rather lightly infuscate to black. The metasternum also is sometimes as dark as the abdomen, but occasionally is no darker than the elytra.

EUPINODA HIRTICEPS, n.sp.

♂. Dark castaneous-brown; elytra bright castaneous, but suture, base, and apex infuscated; legs, palpi, and two apical joints of antennæ flavous. Head with rather dense, pale hairs; abdomen sparsely pubescent, elsewhere with a few rather long hairs.

Head wide, with a strong median carina, apparently foveate towards base. Antennæ long and thin, ninth joint rather small but about twice the size of eighth, tenth about twice as long as ninth, and produced on one side of apex, eleventh ovate. *Prothorax* almost as long as wide, sides rather strongly inflated in front of the middle. *Elytra* rather large, slightly longer than wide; sutural stria distinct, the dorsal represented by a feeble basal impression; impunctate. *Metasternum* impressed along middle. Under-surface of *abdomen* with a longitudinal carina or tubercle towards base, apex foveate. *Trochanters* apparently unarmed; front tibiæ simple, hind pair dilated and fasciate at inner apex. Length 1½ mm.

Hab.—N. S. Wales: Rope's Creek (type in Macleay Museum).

In general appearance strongly resembles *E. amplipes*, but with the prothorax black, the head hairy, and the front legs different. The head appears to be rather flat, and, in places, foveate, but its sculpture is greatly obscured by the clothing.

RYBAXIS MACLEAYI, n.sp.

♂. Reddish-castaneous, head sometimes dark; antennæ with apical joint flavous, some of the preceding joints black or blackish. With short, pale pubescence.

Head moderately large; with two fairly large, round, closed foveæ between eyes, and a moderately deep impression or open fovea in front. Antennæ with first joint rather long, fifth slightly longer but thinner than fourth, sixth about as long as fourth; seventh the length of sixth, but considerably wider; eighth small but transverse; ninth moderately large, transversely suboblong; tenth longer but not wider than ninth; eleventh scarcely as long as ninth and tenth combined, its apex slightly produced on one side. *Prothorax* feebly transverse, widest at apical third, with a very feeble medio-basal fovea, but a distinct curved impression continued to each side from same, each impression terminating in a large fovea. *Elytra* almost as long as wide, each with the sutural stria distinct, the dorsal distinct to near apex, at its apex directed slightly outwards; epipleural furrow deep, lightly curved, not quite extending to base or apex; punctures rather indistinct. *Metasternum* widely impressed in middle, each side with an obtuse tooth overhanging the posterior coxa. *Abdomen* flattened along middle of under-surface. *Legs* rather stout; trochanters unarmed; front tibiæ dentate slightly nearer base than apex. Length 2-2¼ mm.

♀. Differs in having the head smaller, antennæ shorter, third to eighth joints subequal in size, tenth considerably larger and wider than ninth, and eleventh longer than ninth and tenth combined; metasternum unarmed and much less excavated along middle; abdomen rather strongly convex along middle of under-surface, and legs unarmed, and somewhat thinner.

Hab.—N. S. Wales: Richmond River(Macleay Museum).

Belongs to a rather numerous group of species that, at first sight, all look much alike, but are usually readily distinguishable by the antennæ, legs, and under-surface of the males. In general appearance, it is very close to *R. parvidens*, but the front tibiæ of the male are more conspicuously armed in the middle, the metasternum differently armed, and the antennæ not quite the same. *R. quadrituberculata*, to which it is also allied, has the armature of the front tibiæ nearer the apex than base. *R. adumbrata* also has the tibial armature nearer the apex than base, and differs also in the metasternum and antennæ. *R. quadriceps* has the seventh and eighth joints acutely produced inwards, but is very close in other respects. *R. grandis* appears to be allied, but its female (the only sex known) is described as having its apical ventral segment bi-impressed. There are several species, the females of which almost exactly fit the description of *R. grandis*. *R. optata*, from Victoria, is described as having the prothorax "with no trace of the central fovea." Its legs are not mentioned, but it belongs to a group, the males of which nearly always have very distinctive legs.

The head is sometimes considerably darker than the prothorax (both sexes), the dark joints of the antennæ vary in number from five (6th-10th) to two (9th-10th). From some directions, the seventh joint appears no wider than the sixth; the ninth, on some of the males, appears to have a small process on one side of its apex, but this may be due to matted pubescence.

RYBAXIS METASTERNALIS, n.sp.

♂. Pale reddish-castaneous, abdomen somewhat darker, legs (knees excepted) and palpi flavous. With short pale pubescence.

Head with a fairly large, round, closed fovea close to each eye, a shallower one in front. Antennæ thin, none of the joints transverse, fifth slightly larger than sixth, and just perceptibly larger than fourth, eighth smallest of all; ninth distinctly longer and wider than eighth, and smaller than tenth; eleventh subovate, about as long as ninth and tenth combined. *Prothorax* distinctly transverse, sides strongly rounded, and widest slightly in front of the middle; foveæ and impressions as in the preceding species, except that the medio-basal fovea is more distinct, although not large. *Elytra* slightly wider than long, each with the sutural stria distinct, the dorsal distinct at base, and traceable to about apical fourth; epipleural furrow deep, moderately curved, terminated at about basal fifth and apical fourth; with numerous feeble punctures. *Metasternum* with a distinct process or tooth, commencing near its apex, and extending to between middle coxæ, its tip upturned. *Abdomen* irregularly excavated on under-surface, and with feeble tubercles. *Legs* moderately stout; front tibiæ obtusely dentate almost in exact middle. Length 2½ mm.

Hab.—N. S. Wales: Rope's Creek (Macleay Museum).

Readily distinguished from all other described species by the remarkable process on the metasternum, which is very distinct from the sides; the process is somewhat similar to that on the males of several species of *Mandalotus* (*M. hoplostethus*, *M. intercoxalis*, etc.), only it is placed on the metasternum, instead of on the mesosternum. There were two males of the species, in the Macleay Museum, standing under the name of *R. optata*, but they are not even close to the description of that species, differing in the abdomen, metasternum, prothorax, antennæ, &c.

RYBAXIS SANGUINIPENNIS, n.sp.

♂. Black, elytra red, legs and palpi flavous, antennæ reddish, club black or blackish. With very short, whitish pubescence.

Head with a moderately large, round, closed fovea close to each eye, a rather shallow depression in front. Antennæ rather thin, first joint moderately long, second shorter but no thinner, third, fourth, and fifth rather thin and subequal, sixth and seventh slightly shorter, eighth shorter still, ninth longer and wider than eighth, and shorter and narrower than tenth, eleventh subovate, slightly wider than tenth, and about as long as ninth and tenth combined. *Prothorax* moderately transverse, sides strongly rounded, widest at about apical third; foveæ and impressions much as in *R. Macleayi*. *Elytra* almost as long as wide; each with the sutural stria very distinct, and commencing in a small fovea, dorsal stria distinct at base and traceable to apical fourth, at its apex curved slightly outwards; epipleural furrow deep, lightly curved, commencing at basal and terminating at apical fifth; punctures very indistinct. *Metasternum* rather widely impressed along middle. *Abdomen* flattened along middle of under-surface. *Legs* rather stout; four front tibiæ feebly dentate almost at apex. Length 1½-1⅔ mm

♀. Differs in having shorter antennæ, metasternum less impressed along middle, abdomen convex along middle of under-surface, and legs thinner and unarmed.

Hab.—Tasmania: Latrobe; five specimens, from flood-débris (A. M. Lea).

In general appearance close to *R. atriclava*, but with the front tibiæ dentate almost at apex, instead of near middle, the middle pair also dentate, and the hind pair unarmed; the dentition is not very pronounced, and, at first, appears to be due to pubescence. *R. Harti*, which also has the four front tibiæ dentate, has the teeth in very different positions; it is also a smaller and paler species.

The colour is somewhat variable. Some specimens have the prothorax deep black; in others, it is not much darker than the elytra; the metasternum also varies from blackish to a dingy red; the apex of the abdomen is reddish; and, on the under-surface, the red sometimes extends to the base; the dark joints of the antennæ vary in number from three (the club) to five.

RYBAXIS FOVEICOLLIS, n.sp.

Pale castaneous; tip of abdomen, palpi, and tarsi more or less flavous. With moderately dense, short, whitish pubescence.

Head with a round and almost closed fovea close to each eye, and with a wide and rather shallow depression in front, its front marked by a curved ridge connecting the bases of the antennæ. Antennæ short, first joint longer but no wider than second, third to eighth small, ninth slightly wider than eighth, and narrower than tenth; eleventh ovate, considerably wider than tenth, and about as long as the four preceding combined. *Prothorax* widely transverse, widest at about apical third, with a wide, deep, medio-basal fovea, connected by a short impression on each side with a large lateral fovea. *Elytra* subquadrate; each with sutural stria very distinct, and commencing in a small fovea, dorsal stria represented by a large basal fovea only; epipleural furrow deep, lightly curved, and terminated close to base and apex; punctures rather indistinct. *Metasternum* impressed between hind coxæ. *Abdomen* convex along middle. *Legs* unarmed and comparatively thin. Length 1 mm.

Hab.—N. S. Wales: Tamworth(Macleay Museum).

In size, colour, and antennæ like *R. pallida*, but otherwise very different. There are three specimens before me, apparently all females; but I have described them, as the large prothoracic foveæ should be very distinctive; the medio-basal fovea occupies fully half the width of the prothorax, is straight behind, and arched in front.

PSELAPHUS FERGUSONI, n.sp.

♀. Bright reddish-castaneous, elytra and appendages paler. Tip of elytra, base of abdomen on under-surface, and part of under-surface of head with dense, short pubescence, upper surface of abdomen with sparse pubescence, elsewhere almost or quite glabrous.

Head with a wide median groove not quite extending to base, a feeble elevation between eyes. Antennæ extending to middle coxæ; second joint shorter than first, but no narrower; ninth subovate, about once and one-half the length and almost twice the width of eighth; tenth slightly larger than ninth, but much the same shape; eleventh not as long as the two preceding joints combined, its apex obtuse. Palpi long and thin, club of apical joint about one-half the length of peduncle. *Prothorax* slightly longer than wide; close to base with a moderately wide, transverse impression, in which are four small foveæ. *Elytra* almost as long as wide; each with the sutural and dorsal striæ distinct, the latter gently curved. Length 1¼ mm.

Hab.—N. S. Wales: Sydney, Rope's Creek(E. W. Ferguson).

About the size of *P. Leanus*, and slightly smaller than *P. tuberculifrons*, but with considerably shorter antennæ, whose terminal joints are also of a different shape; *P. flavipalpis* is slightly larger, differently clothed, the head wider, and antennæ somewhat longer; all the other species known to me are decidedly larger.

PSELAPHUS SUBSQUAMOSUS, n.sp.

♀. Bright reddish-castaneous, appendages more or less flavous. Rather densely (for the genus) clothed all over upper surface with short white pubescence, becoming very dense at tip of elytra, and at base of abdomen on under-surface.

Head with median groove shallow and partially obscured by clothing. Antennæ rather thin, second joint distinctly shorter and slightly narrower than first, joints of the club rather thinner, but otherwise as in the preceding species. Palpi (for the genus) not very long, club of apical joint the length of peduncle. *Prothorax* about as long as wide, basal half almost parallel-sided; a transverse impression at base, marked by three foveæ, but somewhat obscured by clothing. *Elytra* about as long as wide; each with the sutural and dorsal striæ distinct, the latter rather strongly curved. Length, 1¾ mm.

Hab.—New South Wales: Narromine (E. W. Ferguson).

The clothing causes a peculiar, greyish, scaly appearance on the upper surface, and renders the species so distinct, that I have not hesitated to describe the only female I have seen.

CTENISOPHUS SUBLONGICORNIS, n.sp.

♂. Pale castaneous, palpi and tarsi still paler. Clothed with very short, whitish pubescence, denser at tip of elytra than elsewhere.

Head rather wide; the interocular foveæ smaller and shallower than usual. Antennæ long, extending almost to tip of elytra. *Prothorax* slightly wider than long, widest close to apex, sides thence oblique to base; with a large, shallow, medio-basal impression. *Elytra* slightly wider than long; each with the sutural stria distinct, the dorsal distinct to beyond the middle, but very feeble towards apex. *Metasternum* deeply grooved along middle. *Abdomen* with a wide and very feeble median impression on third segment on under-surface. *Legs* long and thin. Length 1¼ mm.

Hab.—Victoria: Portland (H. W. Davey).

In general appearance, rather close to *C. longicornis*, but rather more compact, antennæ shorter and slightly stouter; the proportions of the joints are exactly as described for those of *C. longicornis*; but, in that species, the antennæ are decidedly longer, so that their nine apical joints are about equal to the eleven of the present species.

CTENISOPHUS LONGICORNIS Lea.

There are sexes of this species in the Macleay Museum, from Wagga Wagga, New South Wales, but they differ from the types in being somewhat paler. This, however, is a common difference between Australian and Tasmanian specimens.

GERALLUS DECIPIENS, n.sp.

♂. Dark reddish-castaneous, appendages somewhat paler. With pale and somewhat irregularly distributed pubescence; and with two upright bristles between eyes.

Head of moderate size, with a strong, deep, frontal impression, the hind margin of which is somewhat curved, between antennæ with a subtriangular elevation, the front of which is supplied with two feeble nodes, and the hind part of which overhangs the transverse impression; with dense and rather coarse punctures. Antennæ elongate, first joint (as viewed from sides) almost as long as the three following combined, eighth lightly transverse, ninth rather strongly, tenth still more strongly transverse, eleventh truncate-ovate. Palpi with apical joint moderately long. *Prothorax* almost as long as wide, widest at about apical third, non-foveate; with punctures slightly sparser than on head, but not smaller. Elytra wider than long; each with the sutural stria distinct, and the dorsal represented by an impression on basal fourth only; with clearly defined punctures, rather sparser than on prothorax. *Abdomen* with numerous but rather small punctures on upper surface; lower flattened along middle. *Metasternum* widely and rather shallowly excavated in middle. *Legs* long; front trochanters with a strong truncate tooth, middle subtriangularly dentate; front femora with a small, acute, subbasal tooth. Length, 1⅔-1¾ mm.

Hab.—Victoria(Macleay Museum).

The peculiar square tooth of the front trochanters readily distinguishes this from all previously described species; the punctures also are coarser. At first, it appears to belong to *Rytus subulatus*, but the palpi are as in *Gerallus*. From some directions, the lower hind part of the cephalic impression appears to have a small flavous fascicle, projecting horizontally forwards, but it is not very distinct.

TMESIPHORUS FOVEILATERIS, n.sp.

Reddish-castaneous; elytra, tarsi, and palpi paler. With rather short, dingy pubescence, denser at tip of elytra than elsewhere; a fascicle of golden hair on each side of base of head; lateral foveæ of prothorax filled with similar hairs.

Head with two rather small interocular foveæ, front rather deeply longitudinally impressed; densely punctate all over. Antennæ not very long; third to tenth joints transverse, ninth and tenth not very large, but much larger than the preceding ones; eleventh briefly ovate, longer than ninth and tenth combined. Palpi with a strong spine on second and third joints, apical joint strongly obtusely produced on one side, and acutely produced at apex. *Prothorax* about as long as wide, widest at about one-third from apex; with a small medio-basal fovea, and a much larger one on each side, but the latter filled with clothing; punctures as on head. *Elytra* moderately transverse; the dorsal stria on each rather wide, but terminated before middle; with clearly defined punctures, but smaller, sparser, and more irregularly distributed than on prothorax. *Abdomen* with a narrow carina on each side of second and third segments; under-surface convex, the first and second segments conspicuously fringed with somewhat golden clothing. *Legs* unarmed; front tibiæ somewhat curved and thickened in middle. Length, 2½ mm.

Hab.—Queensland: Townsville (H. H. D. Griffith, from F. P. Dodd).

The specimen described is probably a female, but the peculiar lateral foveæ of the prothorax render the species remarkably distinct. It is allied to *T. brevicornis* (also from Townsville), but is readily distinguished from that species by the absence of the median ridge from the second dorsal segment of abdomen; the upper surface of the abdomen is shining, whilst in *T. brevicornis* it is subopaque (a character omitted from the original description).

The species is almost certainly myrmecophilous or termitophilous, but there was no indication as to how the type was obtained.

PALIMBOLUS MAMILLATUS, n.sp. (Plate xvii., fig. 1).

♂. Reddish-castaneous, head and prothorax somewhat darker. Rather densely clothed with long, yellowish pubescence.

Head rather elongate, with two small subbasal foveæ, antennary ridges rather long and parallel, the dividing groove not very deep. Eyes small and prominent. Antennæ long, first joint (from the side) longer than second and third combined, fifth slightly longer than fourth, and just perceptibly longer than sixth, ninth slightly wider than eighth, and tenth than ninth, eleventh subovate, strongly notched on under-surface. *Prothorax* strongly convex, slightly longer than wide, sculpture more or less concealed by clothing. *Elytra* slightly wider than long, much wider and longer than prothorax; punctures very indistinct. *Abdomen* long, strongly margined, fourth and fifth segments large; under-surface concave along middle, the apical segment foveate. *Metasternum* depressed along middle, each side of middle with a small conical tubercle. *Legs* rather long; hind trochanters each with a tooth as on metasternum; hind tibiæ with a strong inner median flange. Length, 4¼ mm.

Hab.—Tasmania: Mount Wellington (H. H. D. Griffith).

Readily distinguished from all other described species by the peculiar wide flange of the hind tibiæ; each flange commences at one-third from the base, is oblique to its widest part, then slightly curved, then pointed, and strongly notched to the tibia, where it ends at about one-third from the apex. The tibia itself is tipped with a small acute hook. The under-surface of the terminal joint of the antennæ is somewhat as in *P. Victoriæ.* The general shape is somewhat like that of *P. elegans* on an enlarged scale.

COLLACEROTHORAX, n.g.

Head rather short, deeply grooved along middle. Eyes of moderate size, lateral, and prominent. Antennæ rather short. Palpi small, first joint concealed, second thickened to apex and slightly curved, third rather stout, about one-half the length of second, fourth obovate, slightly shorter than second. *Prothorax* transverse, widest near apex, strongly sculptured. *Elytra* transverse. *Metasternum* of moderate length. *Abdomen* strongly margined on upper surface, third and fourth segments larger than the others, second tri-, the third bicarinated. *Legs* moderately short; tarsi with first joint very short, second moderately long, third longer than first and second combined, with two thin claws.

The general appearance of the insect described below is as of a stout, hairy *Palimbolus;* and, for the present, the genus may be placed between that and *Tryomorphus,* from both of which it is distinguished by the carinated abdomen. *Tmesiphorus,* with somewhat similar abdomen, has very different palpi. The sculpture of its prothorax is very peculiar, and the only prothorax figured by Raffray at all resembling it, is that of *Apharinodes squamosus*,* from Singapore; but it is not much like it, and the head and abdomen are very different.

COLLACEROTHORAX SCULPTICEPS, n.sp. (Plate xvii., figs. 2-4).

Dark reddish-castaneous, elytra (suture excepted), legs, and palpi paler. Clothed with numerous rather long, blackish hairs; and, in places (notably on abdomen, and under-surface), with shorter and pale pubescence.

Head lightly transverse; with a wide, deep, median groove, somewhat irregular in front and open behind, the groove bounded on each side by a ridge terminating posteriorly in an acute tooth directed obliquely backwards; between each ridge and the side, a shallow groove, the hind end of which is closed, and marked by a feeble tooth; with numerous, but partially concealed punctures. Antennæ rather short and stout, the three apical joints forming a rather wide club. *Prothorax* wider than head, rather suddenly dilated near apex; the dilated part, on each side, with a strong excavation, which is narrowed in front, and irregular towards base, filled with pubescence and hairs; with a strong, median impression on basal half; with numerous but usually concealed punctures. *Elytra* transverse. Sutural stria distinct, the dorsal represented by a rather short basal groove; with small, sparse, and irregularly distributed punctures. *Abdomen*, at widest, slightly wider than elytra, second segment with three equidistant carinæ, of which the outer ones are smaller, but more prominent than the middle one, third with two carinæ not quite extending to apex; under-surface gently flattened along middle, the fifth segment semicircularly emarginate at apex. *Legs* unarmed. Length, 2½ mm.

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* Rev. d'Ent. 1890, Pl. ii., fig. 40.

Hab.—New South Wales: Blue Mountains, Sydney (E. W. Ferguson).

The sculpture of the prothorax is more or less obscured by the clothing. The base of the head, when viewed from behind, appears to rise above the prothorax in the form of four more or less conical tubercles. The two specimens before me are evidently of but one sex; and, despite the unarmed legs, are probably males. The one from Sydney differs from the type in being paler (its elytra are almost flavous), the eleventh joint of antennæ paler than tenth, and the clothing sparser and paler.

TYROMORPHUS FLAVIMANUS, n.sp.

♂. Reddish-castaneous; club infuscate, palpi and tarsi flavous. With very short, pale pubescence.

Head rather strongly transverse, not including the eyes, about as long as wide; with a small fovea on each side slightly in advance of eyes, front depressed in middle. Antennæ extending to about middle of elytra; first joint about as long as second and third combined, second slightly larger than third, third to eighth subequal, ninth and tenth subequal and considerably larger than eighth; eleventh ovate, about as long as ninth and tenth combined, and somewhat wider. *Prothorax* almost as long as wide, widest near apex, sides thence feebly decreasing in width to base, with numerous small but clearly defined punctures; with a small medio-basal fovea. *Elytra* lightly transverse, each with the sutural stria distinct, the dorsal deep at base and continued to beyond the middle; with feeble but rather dense punctures. *Metasternum* widely excavated along middle; the excavation continued on abdomen almost to its apex. Middle *trochanters* with a wide triangular tooth; middle tibiæ forked at apex. Length, 2 (vix) mm.

Hab.—N. S. Wales: Blue Mountains (E. W. Ferguson).

Readily distinguished from *T. nigricornis* by the ventral excavation and middle legs. *P. lævis* has the middle tibiæ dentate in middle, and the front trochanters armed; its surface also is very feebly punctured. In Raffray's Table*, it would be associated with *T. humeralis* (except that the head could scarcely be called rounded), but it differs from the figure of that species in having the head shorter, with more prominent eyes, the middle tibiæ armed, and the front pair unarmed.

RYTUS INSIGNICORNIS, n.sp. (Plate xvii., fig. 5).

♂. Reddish-castaneous, legs somewhat paler, palpi and tarsi still paler. Wtih moderately long, and not very dense, pale pubescence.

Head of moderate size, deeply transversely excavated towards the front, the excavation with a strong semicircular backward extension at middle, so that the extension appears to be margined by a strong, obtuse horn on each side; with a strong, curved elevation between antennæ, the elevation then narrowed and depressed posteriorly, and then with a strong tubercle at its apex, which is slightly in front of and between the obtuse horns; with moderately distinct punctures. Antennæ with first joint rather short and stout, second gently transverse, third and seventh each about twice as wide as long; fourth, fifth, and sixth each more than thrice as wide as long, and feebly concave on their under-surface; fifth widest of all; eighth almost as wide as seventh, but much shorter; ninth rather strongly, tenth moderately transverse; eleventh rather thin, slightly longer than the three preceding joints combined. *Prothorax* widest near apex, with moderately distinct punctures on sides, but feeble along middle. *Elytra* almost as long as wide; punctures very indistinct; each with two small basal foveæ. *Metasternum* moderately impressed. *Abdomen* gently flattened along middle of under-surface. *Legs* long; middle trochanters subtriangularly dentate. Length, 2 mm.

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* These Proceedings, 1900, p.228.

Hab.—N. S. Wales: Narromine (E. W. Ferguson).

Readily distinguished from all others of the genus by its remarkable antennæ. The sculpture of the head is also remarkable.

RYTUS PORCELLUS Schfs.

There are before me three males (from the Blue Mountains and Sydney) that agree well with Raffray's notes on the types of *R. porcellus*, and I believe them to be that species. He thought that the species was probably *R. corniger*, but this is not the case, as the latter is a smaller species, with rather coarse punctures; and is much like *R. Kingi.*

HAMOTOPSIS METASTERNALIS, n.sp.

♂. Reddish-castaneous; head, prothorax, and abdomen somewhat darker than elsewhere. With moderately dense, and not very short, yellowish pubescence.

Head, excluding eyes, decidedly longer than wide; with dense and rather coarse punctures, except in middle, which is shining and with two conspicuous but rather small foveæ; front rather deeply impressed between antennary ridges. Antennæ moderately long, first joint, from above, about as long as the two following combined; from the side, the three following combined; ninth slightly wider than eighth; tenth slightly longer and wider than ninth; eleventh very large, largely produced on one side. Palpi with apical joint very large, about as long as the two basal joints of antennæ. *Prothorax* strongly convex, longer than wide, widest at about apical third, thence rather strongly diminishing in width to base; each side near base with a rather large impression, the two connected across middle by a curved line; behind this line the punctures are denser and coarser than in front of it. *Elytra* lightly transverse; each with the sutural stria distinct and commencing in a small fovea, the dorsal subfoveate near base, but not traceable to middle; with small punctures.

Metasternum with a conspicuous median keel, commencing at the middle and overhanging the base of the abdomen like a conical tubercle. *Abdomen* scarcely flattened along middle of under-surface. Front *trochanters* with a small, acute tooth. Length, 3 mm.

Hab.—S. Australia: Adelaide (H. H. D. Griffith).

Readily distinguished from the two previously described species, by the metasternal keel. In size and general appearance, it is remarkably close to the male of *H. auricomus*, but the basal impressions of the elytra are larger. On the type, on the upper surface of its abdomen, on the second (apparently the first) segment, there is a very narrow longitudinal carina, but as it is slightly oblique and not exactly median, it may not be typical.

HAMOTOPSIS AUSTRALASIÆ Raffr.

Only the female of this species has been described. There are two males, from Gayndah and Wide Bay, before me, that appear to belong to the species. They differ from the female in having the front trochanters armed with a small and moderately acute tooth, and the front femora with an obtuse but distinct subbasal tooth. The abdomen is flattened along the under-surface, and appears to have small irregular impressions.*

The male is readily distinguished from the male of *H. auricomus* by the femoral tooth; the tooth of the trochanter is also less acute and more depressed, and the front tibiæ are without a small apical spur.

SCHISTODACTYLUS BREVIPENNIS Lea.

Dr. Ferguson has a specimen of this species from the Blue Mountains, N.S.W.

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* One of the specimens is without its abdomen; and that of the other is very dirty, and I have not been able to clean it so as to see the sculpture clearly.

Family SCYDMÆNIDÆ.

SCYDMÆNUS KINGENSIS, nom. nov.

S. Kingi Lea (nom. præocc.).

This name is proposed as a substitute for that of the King Island species, named after the late Rev. R. L. King; the name *Kingi* was previously used in the genus for a species from Gayndah.

Family SILPHIDÆ.

CLAMBUS FLAVIPES, n.sp.

Blackish-brown and highly polished; sides and base of prothorax and margins of elytra more or less diluted with red; appendages flavous; hind coxæ blackish-brown at the base, becoming paler towards apex. Slides with sparse, pale, and extremely short pubescence.

Elytra with rather dense but very minute punctures, and without subsutural striæ. Hind *coxæ* with very minute punctures, and, as also the metasternum and abdomen, highly polished; each about as big as each side of metasternum. Length, 1 mm. (vix).*

Hab.—Tasmania: Gordon River (J. E. Philp).

Of the size of *C. Simsoni*, and also without subsutural striæ, but the upper surface is differently clothed, and the metasternum and hind coxæ are highly polished as in *C. myrmecophilus*. The clubs of the antennæ of the type are concealed.

CLAMBUS PUBIVENTRIS, n.sp.

Blackish-brown and highly polished, sides and base of prothorax and margins of elytra more or less feebly diluted with red; under-surface, including hind coxæ, dark reddish-brown;

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* The lengths given are with the head curved over in the usual position of dried specimens.

appendages of a somewhat dingy flavous, club black. Almost glabrous.

Elytra with very minute punctures; subsutural striæ distinct from basal fourth to apex. Hind *coxæ* larger than metasternum, and, as also the under-surface generally, clothed with fine pubescence. Length, 1 mm.

Hab.—Tasmania: Mount Wellington (A. M. Lea).

Smaller, darker, and less convex than *C. latens*. From *C. Tierensis* it differs in being smaller, less convex, and not entirely glabrous on the upper surface. At a glance, it appears to be glabrous, but the elytra have a few rather short setæ on the sides towards apex.

CLAMBUS LATENS, n.sp.

Of a rather dingy reddish-brown, but highly polished, prothoracic and elytral margins slightly paler, under-surface and appendages more or less flavous, but club blackish. Elytra with extremely sparse, short, and inconspicuous setæ.

Elytra with extremely minute punctures; subsutural striæ distinct from basal third to apex. Hind *coxæ* about twice the size of metasternum, and, as also the under-surface generally, rather densely pubescent. Length, 1¼ mm.

Hab.—Tasmania: New Norfolk, in moss; Stonor, probably from tussocks (A. M. Lea).

Of the size, and with the subsutural striæ of *C. Tierensis*; but paler; and elytra with a few setæ, although much shorter and sparser than in *C. Tasmani*, from which also it is very different in other respects. At a glance, it is quite remarkably like some species of *Litochrus*.

CLAMBUS RUFOCASTANEUS, n.sp.

Reddish-castaneous and highly polished; appendages, including club, flavous. Elytra with a few long straggling hairs.

Elytra apparently impunctate; subsutural striæ distinct from basal third to apex. Hind *coxæ* about once and one-half the size of metasternum, and, as also the under-surface generally, rather densely pubescent. Length, 1⅕ mm.

Hab.—Tasmania: Huon River, in tussocks (A. M. Lea).

Rather smaller than *C. Tasmani*, and entirely pale, but with very similiar clothing, and with subsutural striæ.

CLAMBUS CORYLOPHOIDES, n.sp.

Reddish-castaneous, parts of elytra darker, appendages, hind coxæ excepted, flavous. With very short, pale, and, for the genus, dense pubescence.

Upper surface with very minute punctures, more distinct, but still very small, on elytra than elsewhere; subsutural striæ rather faint, but traceable from near middle almost to apex. Hind *coxæ* about the size of metasternum, and, as also the under-surface generally, with dense fine pubescence. Length ⅘ mm.

Hab.—Tasmania: Hobart(A. M. Lea).

The upper surface with dense fine pubescence (much more noticeable than in *C. Simsoni*) readily distinguishes it from all other species known to me. At a glance, it looks like a member of the *Corylophidæ*. It is rather more convex than usual, with the elytra strongly narrowed posteriorly. When the head is closely applied to the under-surface, as in dried specimens, it almost extends to the hind coxæ. The subsutural striæ are very feeble. The clubs of the antennæ are concealed on the three specimens before me.

CLAMBUS TASMANI Blackb.

This species may be obtained abundantly in moss in many parts of Tasmania. The suture is usually paler than the discs of the elytra, but an occasional specimen may have the elytra entirely black.

CLAMBUS SIMSONI Blackb.

This species is abundant in Tasmania, and I have specimens from many parts of New South Wales. It is obtainable from moss, but occurs on fence-tops, &c., at dusk. Mr. Simson has kindly lent me a specimen bearing his own number, 3344, and a name-label of Mr. Blackburn's.

The species is readily known by its fine elytral pubescence, and the absence of the subsutural stria. Its colouring, however, is decidedly variable. Tasmanian specimens have the elytra usually of an almost uniform smoky-brown, sometimes paler on the disc, with the pale markings occasionally appearing almost like two large spots. Occasionally only a large subtriangular patch about the scutellum is dark. The prothorax usually has the sides and the extreme base paler than the disc.

Specimens from New South Wales are usually paler than Tasmanian ones, and two before me have the upper surface entirely pale.

CLAMBUS TIERENSIS Blackb.

Mr. Blackburn described the colour of this species as "marginibus lateralibus anguste rufescentibus." This applies to several specimens before me, but in the majority of them the elytra are entirely dark. Occasionally the base of the prothorax is narrowly reddish. In the description no mention is made of a subsutural stria; but later on (under that of *tropicus*) it is mentioned as being present.

The species (Mr. Simson's 3520 and 3703) is fairly common in Tasmania, and specimens may occasionally be taken in moss.

ANISOTOMA WIBURDI, n.sp.

Reddish-castaneous, appendages somewhat paler.

Head with dense minute punctures. Club large, fully one-half the length of antennæ. *Prothorax* with punctures as on head, but not quite as dense. *Elytra* with rows of rather small but distinct punctures, becoming absent at base and on shoulders, and semidouble in places, especially towards the sides; interstices with minute but rather clearly defined punctures, as distinct on shoulders as elsewhere. *Metasternum* with dense and fairly coarse punctures, but much finer in middle. *Legs* short and wide; hind femora somewhat angularly dilated at inner apex; front tibiæ moderately wide and with a few stiff setæ, the others wider and with more numerous setæ of various sizes. Length $2\frac{1}{2}$ mm.

Hab.—N. S. Wales: Vicinity of Jenolan Caves (J. C. Wiburd), Forest Reefs (A. M. Lea).

Very much the size and appearance of *A. Tasmaniæ*, but hind femora edentate; they are, however, somewhat angularly dilated at the inner apex.

The specimen from Forest Reefs differs in being almost flavous, but is probably immature.

ANISOTOMA MICROPUNCTATA, n.sp.

Pale castaneous, appendages still paler.

Head and *prothorax* scarcely visibly punctate. *Elytra* with very feeble rows of feeble punctures, not extending to base or shoulders, the interstices without visible punctures. *Metasternum* densely punctate at sides, but shining and impunctate along middle. *Legs* short and wide; hind femora somewhat angularly dilated at inner apex, but not dentate; tibiæ wide, with short stiff setæ. Length $1\frac{1}{3}$ mm.

Hab.—N. S. Wales: Tweed River (A. M. Lea).

A small species, with unusually fine punctures.

ANISOTOMA BICOLORICLAVA, n.sp.

Pale castaneous, appendages more or less flavous, but club (except apical joint) infuscate.

Head with dense and minute but fairly distinct punctures. *Prothorax* with sparser and still smaller punctures. *Elytra* with regular rows of distinct punctures, terminated some distance from base; the interstices impunctate. *Metasternum* with dense and fairly strong punctures at sides, becoming smaller towards, and quite absent from, middle, which is smooth and shining. *Legs* short and wide; hind femora each with a triangular flange-like extension at inner apex; tibiæ wide, especially the four hind ones, and with short stiff setæ. Length $1\frac{1}{2}$ mm.

Hab.—Tasmania: Huon and Jordan Rivers, Launceston, Frankford (A. M. Lea).

Readily distinguished by its partly dark club; in *A. myrmecophila* the club is entirely dark and the interstices are punctate.

The hind femora each have an almost equilaterally triangular extension of the inner apex, which, however, from some directions appears as a thin apical flange. It should possibly be regarded as a tooth, but, if so, it is very different from the long and comparatively narrow tooth so conspicuous in *A. Tasmaniæ* and the following species.

ANISOTOMA AMMOPHILA, n.sp.

Reddish-castaneous, appendages somewhat paler.

Head with dense but very minute punctures. *Prothorax* with extremely minute punctures, scarcely visible except on sides. *Elytra* with regular rows of distinct but small punctures, not extending to base; interstices impunctate, but a few small punctures about shoulders. *Metasternum* with dense punctures at sides. *Legs* short and wide; hind femora at apex each with a strong acute inner tooth; tibiæ wide, especially the four hind ones and with short, stiff setæ. Length 2(vix)mm.

Hab.—Tasmania : Hobart(A. M. Lea).

In general appearance close to *A. myrmecophila* and *A. Tasmaniæ*; from the latter, distinguished by the impunctate elytral interstices; and from the former, by the armed femora; the femoral teeth are large, but rather shorter and stouter than in *A. Tasmaniæ.* A single specimen was taken in sand, whilst hunting for species of *Phycochus* at Sandy Bay.

The Australian species of this genus, at any rate those known to me, so closely resemble each other in general outlines, that they are not very easily distinguished, and the following table may therefore be useful.

Hind femora each with a long strong tooth at apex.	
Interstices with small punctures..........................	*Tasmaniæ* Oll.
Interstices without punctures........	*ammophila*, n.sp.
Hind femora edentate.*	
Club partly dark...	*bicoloriclava*, n.sp.
Club entirely dark...........	*myrmecophila* Lea.
Club entirely pale.	
Interstices impunctate...........	*micropunctata*, n.sp.
Interstices with small punctures......................	*Wiburdi*, n.sp.

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* They sometimes have a thin, flange-like extension, however.

ANISOTOMA TASMANIÆ Oll.

Three specimens from Bruni Island (Tasmania) agree with the description of this species.

The hind femora, at the inner apex, have a strong, acute spine about one-half the length of the tibiæ; but, though of such a size, it is more or less concealed, from several directions, when the tibiæ are pressed close to the femora, which probably accounts for the omission of any mention of it in the original description. From some directions, however, it is very conspicuous.

Family BYRRHIDÆ.

MICROCHÆTES BRYOPHILUS, n.sp.

Black, opaque; antennæ of a dingy-brown colour, club darker. With fairly numerous, stiff, erect setæ.

Head round, almost vertical, and with rather coarse punctures. *Prothorax* more than thrice as wide as long, base more than twice the width of apex; with moderately dense but rather small punctures. *Elytra* subcordate, base closely applied to, and scarcely wider than prothorax, diminishing in width from base to apex; with regular rows of fairly large punctures; interstices slightly uneven. *Under-surface* with dense and rather coarse punctures; and with excavations into which the legs can be completely fitted when at rest. Length 1½ mm.

Hab.—Tasmania: Waratah, five specimens from moss(A. M. Lea).

A small species like *M. minor*, but the upper surface with erect setæ only, instead of with dense pubescence as well, and consequently there is no need to abrade the surface before the punctures become visible.

The legs, when at rest, are completely within their receptacles, so that they do not rise above the general level of the sterna and abdomen; the receptacles for the middle pair slightly force out the margins, so that the shoulders appear slightly protuberant.

Family SCARABÆIDÆ.

DIAPHONIA FRENCHI, n.sp.

♂. Black, highly polished. Under-surface and legs with not very long and irregularly distributed hairs and setæ.

Head small; with irregular punctures, much denser on clypeus than elsewhere. Clypeus with sides at apex raised and strongly rounded. Antennæ with joints of club as long as head is wide across eyes. *Prothorax* moderately transverse, subtriangular, sides gently rounded and slightly thickened; almost impunctate along middle, then with small and sparse punctures, becoming larger and denser towards sides. *Elytra* with sparse and small punctures about base, shoulders, and towards suture, elsewhere with transverse impressions, becoming dense at the sides, so as to cause these to appear sublaminated. *Abdomen* with second, third, and fourth segments rather shallowly impressed in middle. *Pygidium* with dense concentric impressions. Front *tibiæ* with outer edge thin, and terminated by a rather strong tooth; middle tibiæ with two strong apical teeth, in addition to spines, and subdendate about middle, hind tibiæ with a strong tooth at apex and subdentate about middle; all the tibiæ fringed with brownish hairs. Length 28 mm.

♀. Differs in being larger and wider; clypeus rather wider, and with still denser punctures; punctures of prothorax denser and more regular; abdomen convex along middle; club about one-half the size, and front tibiæ bidentate externally. Length 29-32 mm.

Hab.—Queensland: Ingham (C. French), Cairns (Edmund Allen).

Readily distinguished from previously described species by its deep, shining black colour. The outlines of the male are almost exactly as in *D. dorsalis*, but the female is rather bulkier.

On one female, each shoulder, almost at its extreme margin, is diluted with red for a space of about 3 mm. in length. On another, the elytra have a very faint greenish gloss, quite invisible from most directions. The type-male is in Mr. French's Collection, the type-female in my own.

CHLOROBAPTA TIBIALIS, n.sp.

♂. Black, highly polished; with bright green markings. Upper surface with short, sparse setæ, but between eyes denser and longer; under-surface with irregularly distributed setæ and hairs, much longer and stouter on hind tibiæ than elsewhere.

Head with irregular punctures, coarser and denser between eyes than elsewhere, an impunctate space in middle of neck; clypeus with a wide shallow groove on each side, its apex widely rounded and thickened at sides, and very feebly incurved to middle. *Prothorax* moderately transverse, sides thickened, the basal two-thirds almost parallel; with small scattered punctures. *Elytra* with a wide irregular longitudinal impression along middle of each disc; with small and sparse punctures; about sides and apex with sinuous transverse impressions. *Abdomen* with a median depression on four basal segments. *Pygidium* with concentric impressions starting from two small spaces at its extreme tip. *Legs* obliquely impressed; front tibiæ thin, with a curved apical tooth and two smaller ones; middle tibiæ stouter, apex with two acute teeth (in addition to the spines), and a small median one; hind tibiæ still stouter, near the base with a conspicuous fascicle of long hairs, about middle with a strong tooth, then strongly incurved to apex, with the apex itself produced as a strong hook continuing the curve, middle claws uneven, the inner one much as the others, but the outer one somewhat shorter, much wider, strongly curved on its outer edge, and notched near its base on the inner edge. Length 19 mm.

Hab.—Queensland: Ingham (type in Coll. C. French).

The specimen described at first appeared to me to be a variety of *C. Besti*, but it is at once distinguished from that species by the hind tibiæ; the markings differ in being of a much brighter green; the black shoulder-spot of *C. Besti* is, in this species, produced obliquely backwards so as to join in with the median spot, but this is not enlarged. The punctures also are considerably smaller, this being notably the case on the prothorax.

The green occupies the greater portion of the clypeus. On the prothorax, it margins the sides and apex; and, at about one-third from the apex, is marked by a small black spot on each side. On the elytra, an oblique irregular vitta extends from each shoulder to about the middle; beyond the middle there is an irregular fascia not quite touching the suture; each side of the apex has a narrow curved stripe, and there is a narrow stripe on each outer margin from the base almost to the postmedian fascia. On the pygidium, there is a subtriangular spot on each side, each with a small median black spot. On the mesosternum, there is a small spot on each side; and a larger one on each side of the metasternum. On the abdomen, the first segment has a curved spot on each side partly visible from above; the second, third, and fourth have a transverse spot on each side of the middle, and a smaller subtriangular one on each side; and the fifth has a wide median spot or fascia not quite extending to the sides.

PLATYDELOSIS VELUTINA Macl.

Mr. C. French has, from Somerset (Queensland), a specimen of this species, with the whole of the upper surface highly polished. A specimen in my own collection, from the Endeavour River, has the derm polished in patches. Under a Coddington lens, the polish appears as if due to varnish, but I think it is probably due to the effects of some preservative.

CACOCHROA GYMNOPLEURA Fisch.

Mr. C. French has, from the Endeavour River, a specimen of this species, that differs from the typical form in having the elytra darker than the prothorax, the latter with a rather small infuscate spot on each side (smaller and more marginal than in the bimaculate variety of *C. variabilis*). The pygidium is of a brighter colour, with only the extreme margins blackish; the femora reddish, and the tibiæ and tarsi darker, but not black (as in the normal form).

A specimen in my own collection, from near the Jenolan Caves, is smaller, more convex, and hairier than usual, with the prothorax, legs, and pygidium entirely deep black, and the elytra blackish only about the shoulders.

Family LYMEXYLONIDÆ.

HYLECŒTUS FUSCIPENNIS, n.sp. (Plate xvii., fig.7).

♀. Reddish-castaneous, sides of prothorax infuscated, elytra infuscated except about base, which is reddish-flavous; antennæ, except three basal joints, and abdomen infuscated; meso- and metasternum and legs more or less flavous. With very fine pubescence present, but less noticeable on eyes than elsewhere.

Head somewhat rounded, with a distinct neck, near base depressed in middle; with dense, clearly defined punctures. Eyes moderately separated. Antennæ with second joint shorter than first; third slightly longer than first, and as long as fourth but slightly narrower; fourth to tenth subtriangular, very feebly decreasing in size; eleventh elongate-ovate, not as long as the two preceding joints combined. *Prothorax* distinctly longer than wide, sides, apex, and front angles rounded, base bisinuate; punctures rather smaller and less crowded than on head. *Scutellum* about as long as wide; with dense punctures. *Elytra* about four times as long as wide, with small dense punctures; each with three feeble costæ. *Legs* long and thin. Length, 11½ mm.

Hab.—N.S.W.: Forest Reefs (A. M. Lea).

There are both sexes of the species before me, but the female was described as the male (7 mm. in length); and has both antennæ broken; of the joints that are left, the fourth to ninth are produced more to one side than in the female, so as to be subpectinate, rather than subtriangular; its eyes are rather closer together, but the difference in this respect is not striking. The ovipositor of the type is extended, and measures 7½ mm.

Readily distinguished from *H. linearis*, and *H. pervagus*, by its partly dark elytra; and from *H. australis*, by not being uniformly dark.

HYLECOETUS VIGILANS, n.sp. (Plate xvii., fig. 8).

Head blackish, prothorax and scutellum reddish-castaneous; elytra reddish-testaceous; under-surface and appendages paler. With moderately dense, short, depressed pubescence, becoming erect on eyes.

Head very densely punctate. Eyes large, projecting laterally, almost touching along middle. Antennæ with third joint moderately long and triangular, fourth to tenth each rather strongly produced to one side, eleventh almost as long as ninth and tenth combined. *Prothorax* longer than wide, front angles strongly rounded, sides widest near apex, thence oblique to base; with very dense punctures, denser and smaller on an obtusely raised medio-basal space than elsewhere. *Scutellum* longer than wide, apex feebly notched; with very dense punctures. *Elytra* about four or five times as long as wide, punctures smaller and less crowded than on prothorax; each with three feeble costæ, of which the outer one is very faint. *Legs* long and thin. Length, 18 mm.

Hab.—Queensland: Little Mulgrave River (H. Hacker).

The projection of the eyes at the sides causes the base of the head to appear as a wide neck; they almost touch for about one-half their length, so that the part of the head between them appears as a triangle, with its apex narrowly produced. The only specimen before me had a process from the tip of the abdomen that was possibly an ovipositor, although the approximation of the eyes would appear to be masculine. The eleventh joint is of rather curious shape, and appears almost like two joints soldered together—a basal one, somewhat like the tenth, and an apical cone-shaped one. The eyes are much larger and closer together than those of any previously described Australian species.

HYLECOETUS AUSTRALIS Er.

This species varies in length from 7½ to 12½ mm. The prothoracic impression, although fairly wide, is usually faint.

Family PTINIDÆ.

Ptinus medioglaber, n.sp.

Black, appendages reddish. Upper surface in parts with dense variegated clothing, and with more or less erect dark setæ; under-surface and legs with rather dense pale pubescence.

Antennæ long and thin. *Prothorax* longer than wide, widest at apical third; with dense, normally concealed punctures. *Elytra* rather long, shoulders rounded, thence to apical third parallel-sided; with regular rows of fairly large, suboblong punctures; interstices almost or quite impunctate. Length, 2½ mm.

Hab.—Victoria: Wangaratta (A. M. Lea).

In general appearance somewhat like a large specimen of *P. attritus*, but differs in having the shoulders much less rounded (much like those of *P. eminens* or *P. exulans*, whilst in *P. attritus* they resemble those of the introduced *P. tectus*); the glabrous space between the subbasal and postmedian clothing larger, and more perfectly glabrous; the pubescence rather more compact and more prettily variegated, and the erect setæ rather shorter.

On the prothorax, the clothing is mostly dark brown, almost black, and in four longitudinal ridges or fascicles, but with a conspicuous white median line, and a white, variegated with golden, basal line; on the scutellum, it is white; on the elytra, on the basal fourth, it is white, variegated with golden, then to beyond the middle the surface, except for a few erect setæ, is glabrous; then there is a conspicuous white fascia not quite touching the suture or sides; on each side of the suture commencing at the fascia, extending to the apex, and then directed along the sides almost to the fascia, the clothing is golden, the enclosed spaces being almost glabrous. On the head, there is a narrow median line of whitish clothing, and the eyes are somewhat indistinctly encircled with white.

PTINUS GLORIOSUS, n.sp.

Black, appendages somewhat reddish. With dense golden brown clothing, variegated with white and stramineous; elytra, in addition, with rather long brownish hairs on setæ; under-surface and legs with dense whitish pubescence.

Antennæ long and thin. *Prothorax* slightly wider than long; with dense, normally concealed punctures. *Elytra* strongly convex; briflely ovate, shoulders strongly rounded; with regular rows of suboblong punctures, mostly concealed by clothing. Length, 2-2¼ mm.

Hab.—W. Australia: Swan River (A. M. Lea).

Most of the clothing is almost of the same lovely colour as the spots of *P. eminens*, but the elytra are of very different shape, and the prothorax has conspicuous basal markings. On the prothorax, the clothing, except for a conspicuous snowy patch on each side of the base, is entirely golden-brown, and in four conspicuous ridges; on the elytra, the golden-brown clothing covers most of the surface, but leaves a cross-shaped glabrous space, of which the upright commences on the suture at about one-fifth from the base, and extends almost, or quite, to the apex, and is irregularly bounded behind the middle by white or stramineous clothing (the only pale clothing on the elytra); the cross-piece is almost median, and is not quite straight. On partially abraded specimens, the cross is not very evident, and normally it is often inflated on each side towards the apex, so as to be somewhat anchor-shaped. There are five specimens before me, all differing slightly in size, but with almost identical clothing.

PTINUS ANCHORALIS, n.sp.

Black, appendages reddish. Clothing, except on elytra, much as in the preceding species. Shape and sculpture much the same. Length, 2½ mm.

Hab.—W. Australia: Pelsart Island (A. M. Lea).

The clothing on the prothorax, except that the golden tone of the ridges is not quite so evident, under-surface and legs, and the setæ on the elytra are as in the preceding species; but the elytral pubescence is denser, distinctly paler than on the prothorax (except the snowy basal spots), shorter and of uniform colour throughout. The glabrous space is also decidedly anchor-shaped, with its various parts rather narrower. It is also somewhat larger and wider, and slightly less convex.

PTINUS CUPREONIGER, n.sp.

Black with a distinct coppery gloss, appendages reddish. With dense brown clothing, variegated with white on the elytra, on which also there are rather long hairs or setæ; under-surface with short, dense, brownish pubescence, becoming somewhat paler on sides.

Antennæ decidedly long and rather thin. *Prothorax* almost as wide as long, sides strongly rounded, base slightly narrower than apex; with very dense punctures, most of which are visible before abrasion. *Elytra* ovate, strongly convex; with regular rows of somewhat angular and rather large punctures; interstices with sparse and minute punctures or none. *Under-surface* with rather larger punctures than usual. Length, 2¼-2½ mm.

Hab.—Tasmania: Stanley, ten specimens from tussocks on summit of the "Nut" (A. M. Lea).

Apparently allied to *P. imulus*, but the prothorax is distinctly narrowed to the base, where there are also no patches of yellowish pubescence. The derm has a gloss somewhat as in *P. adeps*, but the two species have little else in common.

There are four distinct fascicles on the prothorax; and, on abrasion, they are seen to be supported by feeble tubercular swellings. On the elytra, the pubescence is much sparser than on the prothorax; and a large transverse median space is, except for erect setæ, almost or quite glabrous; towards the base and again beyond the middle, there is some white pubescence that sometimes is distinctly fasciate in arrangement.

PTINUS ALBOHUMERALIS, n.sp.

Very dark chestnut-brown, appendages not much paler. Prothorax with dense chestnut-brown pubescence in four conspicuous ridges; elytra with dense reddish pubescence, except for a white spot on each shoulder, scutellum also with white pubescence; elytra with rather long reddish erect setæ: under-surface and legs with short dense greyish pubescence.

Antennæ long and fairly stout. *Prothorax* about as wide as long, sides strongly rounded, base narrower than apex, with a glabrous median line, and a glabrous subbasal one; punctures normally concealed. *Elytra* rather elongate-ovate, moderately convex; with regular rows of suboblong, partially concealed, punctures. Length, 3 mm.

Hab.—N.S.W.: Glen Innes (A. M. Lea).

The beautiful elytral pubescence is of a redder tone than in *P. cærulans;* the shoulders are more strongly rounded, the white spots are less numerous on elytra, and absent from prothorax, the latter has a glabrous median line, etc. In shape, it is much like *P. egenus*, but the clothing is denser and brighter, and on the prothorax (when viewed from behind) appears in four conspicuous lines, with the glabrous median line much narrower; the antennæ are also somewhat shorter.

PTINUS MICROSCOPICUS, n.sp.

Very pale castaneous, almost flavous. With somewhat golden and not very dense pubescence; elytra, in addition, with moderately long erect hairs or setæ; base of prothorax with snowy clothing. Under-surface and legs with short, dense, white pubescence.

Antennæ long and thin. *Prothorax* about as long as wide, sides moderately rounded, base scarcely narrower than apex;

as long, sides strongly rounded, base narrower than apex,

with dense, partially concealed punctures. *Elytra* ovate, moderately convex; with regular rows of suboblong, partially concealed punctures. Length, 1-1¼ *mm.*

Hab.—W. Australia: Swan River (A. M. Lea).

Readily distinguished from all previously described Australian species, by its minute size. On one of the two specimens before me, the clothing on the elytra is feebly variegated.

PTINUS ALBOMACULATUS Macl.

Black, elytra with a purplish gloss. Clothed with short, stiff, erect, black setæ; with conspicuous snowy spots on head, scutellum, and elytra; under-surface and legs with rather dense, but not uniform, white or whitish pubescence.

Head densely and rugosely punctate. Antennæ long and not very thin. *Prothorax* slightly longer than wide, at base and apex with rows of distinct punctures, the intervening space with rounded sides, convex; with dense and somewhat flattened granules. *Elytra* about twice as wide as prothorax, shoulders rounded, sides thence parallel to near apex; with rows of rather large, deep, suboblong punctures, and with a short scutellar row; interstices impunctate. Length, 3⅜ mm.

Hab.—Queensland: Townsville (H. J. Carter; from F. P. Dodd).

On the head, the snowy clothing forms a spot close to each eye, entirely clothes the scutellum, forms a spot behind the shoulder (common to the seventh and eighth interstices), and a transverse marking beyond the middle, on the third to sixth (inclusive) interstices. The specimens before me are marked "Believe ant-friends."

I had the description of this species drawn up as new; and, although the specimens do not quite agree with Macleay's description of *P. albomaculatus*, I thought it advisable to ask Mr. Carter to compare one with the type of that species. This he did, and wrote that "their upper surfaces were identical in every respect." A fuller description, however, should be useful to Coleopterists.

PTINUS NIVEONOTATUS, n.sp.

Black, very shining, elytra with a slight purplish gloss. Clothed with moderately long, erect, blackish setæ; head with a white spot close to each eye, scutellum with snowy clothing, each elytron with a rounded postmedian snowy spot, common to the third and fourth interstices, under-surface with whitish clothing, and somewhat similar clothing on legs.

Head with partly concealed punctures; with a narrow median carina. Antennæ long and thin. *Prothorax* longer than wide, sides decreasing in width from apex to near base, and then increasing to base; base with one, the apex with two rows of distinct punctures, the intervening space smooth and impunctate. *Elytra* twice as wide as the narrowest part of prothorax, shoulders rounded, sides parallel to near apex; with rows of rather small but deep punctures, and with remnants of a scutellar row; interstices impunctate. Length, 2½ mm.

Hab.—Darnley Island (H. Elgner).

A small, shining species, with longer antennæ than is usual amongst black-legged species.

The Australian species of *Ptinus* known to me may be tabulated as follows:—

A. Elytra parallel-sided, with shoulders lightly rounded.
  a. Appendages black or almost so.
    b. Elytra with pale clothing about suture and apex .... *adeps* Oll.
    bb. Elytra without pale clothing there.
      c. Postmedian markings rounded ....*niveonotatus*, n.sp.
      cc. Postmedian markings transverse.. .. ..*albomaculatus* Macl.
  aa. Appendages more or less reddish.
    d. Clothing nowhere black.......... ....*exulans* Er.
    dd. Clothing partly blackish.
      e. Elytra with a glabrous median space...... ....*medioglaber*, n.sp.
      ee. Elytra without such a space.......... .. .., ... *eminens* Oll.

AA. Elytra ovate, not parallel-sided.
B. Size very minute.. ... .*microscopicus*, n.sp.
BB. Size ordinary.
C. Elytral markings confined to shoulders.
f. Prothoracic clothing in four conspicuous ridges. . *albohumeralis*, n.sp.
ff. Prothoracic clothing not in such ridges..... ....*egenus* Oll.
CC. Elytral markings not confined to shoulders.
D. Prothorax with pale clothing along middle......... .. . *attritus* Oll.
DD. Prothorax without a pale median line.
E. Prothorax without pale basal markings... . *cupreoniger*, n.sp.
EE. Prothorax with snowy basal markings.
F. Elytral pubescence variegated.... . ... *gloriosus*, n.sp.
FF. Elytral pubescence of uniform colour. ....*anchoralis*, n.sp.

Family BOSTRYCHIDÆ.

XYLOPSOCUS BISPINOSUS Macl.(♂).

X. elongatula Macl.(♀); *X. Leai* Lesne(♀).

In examining some twigs of the cultivated fig, in December, 1903, I saw numerous holes made by these insects. In most instances, the hole was made close to a bud, and went almost round the twig, just under the bark. In nearly every instance, two insects were in each drill; the one nearest the entrance and always with its tail blocking up the opening was a male; the other, which was always at the head of the drill, was a female. I never saw these positions reversed.

The explanation seems to be that the males guard the entrance to the drill to prevent the females being devoured by *Cleridæ*, or other insects, which devour so many small boring beetles. Frequently when examined, the male was found dead, but the female living; in other instances, both were found dead, so that it would appear that, even in death, the male protects the young brood. The synonymy is now first recorded.

RHIZOPERTHA DOMINICA, Fabr.

Ent. Syst. 1, 2, p. 359; Lesne, Ann. Soc. Ent. Fr., 1897, p. 332; *R. picea* Marsh; *R. rufa* Hope.

This almost cosmopolitan species can now be recorded from Australia, as it has been sent to me from Cape York (H.

Elgner) and New South Wales (Manilla and Wellington; W. W. Froggatt). Mr. Froggatt informs me that the Wellington specimens were taken from wheat-grains. Monsieur Lesne (to whom I am indebted for the identification) records it as eating biscuits, etc.

Family TENEBRIONIDÆ.

TYPHLULOMA, n.g.

Head wide, sides dilated to in front of middle. Eyes absent. Mandibles short, acutely notched near apex. Antennæ short, most of the joints strongly transverse. Palpi short. *Prothorax* subquadrate. *Scutellum* minute. *Elytra* parallel-sided to near apex; epipleuræ rather wide at the base. *Metasternum* moderately long, episterna moderately wide. *Legs* short and stout; tibiæ bispinose at apex, the front pair strongly dentate externally.

The species described below has a strong general appearance as of a small *Achthosus*, or as if belonging to *Uloma* or *Ulomoides*, but is readily distinguished from all of the *Ulomides* by the absence of eyes. In catalogues, it should be placed near *Uloma*. It is by far the largest blind species as yet recorded from Australia, and the only one from Queensland, although it is practically certain that *Rodwayia* occurs there, and probably *Illaphanus* as well.

TYPHLULOMA INOPS, n.sp. (Plate xvii., fig. 9).

Oblong-elliptic, subdepressed. Reddish-castaneous. Glabrous, except for appendages.

Head about once and one-half as wide as long; clypeal suture very feeble posteriorly; with numerous rather small but clearly defined punctures. Antennæ inserted under the slightly overhanging sides; first joint rather short; second moderately, all the others strongly transverse; second to sixth slightly increasing in width at apex; seventh to ninth much more so; tenth slightly wider than ninth; eleventh longer and slightly narrower than tenth, its apex semicircular. *Prothorax* slightly wider than long, sides near apex gently diminishing in width to apex itself, which is gently incurved to middle, base truncate and hind angles almost rectangular; with clearly defined punctures of somewhat irregular size, but none very large. *Elytra* with regular rows of rather large round punctures, in rather feeble striæ, the interstices with sparse and minute punctures; epipleuræ with dense and rather coarse punctures about base, but much smaller and sparser elsewhere. *Under-surface* with round and usually clearly defined punctures. *Abdomen* with first segment longer than second, second longer than third, and slightly longer than fifth, third longer than fourth. Front *tibiæ* wide, their external apical two-thirds with four strong teeth, middle pair slightly longer, not so wide and spinose on external edge, hind pair spinose only at tip. Length, 4½ mm.

Hab.—Queensland: Little Mulgrave River (H. Hacker).

The type was sent in spirits, with many other small beetles, a few of which were certainly from ants' nests, but many were not. Mr. Hacker when written to, could give me no information as to how he obtained it.

CORIPERA ADAMSI, n.sp.

Black, with a faint coppery gloss in places; tibiæ with a slight purplish gloss; antennal joints in parts diluted with red.

Head densely granulate, and with a number of shallow irregular depressions. *Prothorax* moderately transverse; with numerous small granules, and small, shallow, irregular depressions; margins wide, obliquely raised, and coarsely serrated or lobed. *Scutellum* curvilinearly triangular. *Elytra* feebly raised along suture and sides; with small, dense, and somewhat irregularly distributed punctures; with numerous minute, subobsolete granules, and with numerous, small, shining granules of not uniform size, and becoming more numerous towards and on sides, which, in consequence, appear irregularly serrated; flanks also with dense punctures, subobsolete minute granules and small shining ones. *Undersurface* in parts shining, in parts wrinkled, parts of sterna and of head granulated. *Legs* rather long and thin. Length, 14 mm.

Hab.—Tasmania: Magnet (O. L. Adams).

I have received many curious insects from Mr. Adams, but this is an exceptionally fine species. It was in perfect condition, when first received; but now (owing to postal vicissitudes) has all its appendages damaged. It is remarkably distinct from all previously described species. Each prothoracic margin is divided, as it were, into three lobes; the apical one is large and feebly divided into two; the median one is slightly larger, and more distinctly divided: then there is a deep notch, and a smaller, simple lobe. The granulation of the elytra is also very distinctive.

Family EROTYLLIDÆ.

EPISCAPHULA HERCULES, n.sp. (Plate xvii., fig. 10).

Black, shining; an irregular stripe on each side of prothorax, a spot on each shoulder, another between it and scutellum, and a subapical spot on each elytron, dull red. Apex of tibiæ, and lower surface of three basal joints of tarsi, with dense reddish setæ.

Head with moderately distinct punctures behind eyes and on clypeus, elsewhere almost or quite impunctate. *Prothorax* about once and one-fourth as wide as long; each side of base with a narrow, oblique, distinct, impunctate impression. *Elytra* with distinct but small punctures in regular series; interstices with sparse and still smaller punctures. *Abdomen* with distinct punctures along middle and at apex. Front tibiæ with a subtriangular extension at the basal third. Length, 23 mm.

Hab.—Queensland: Coen (C. French).

A single specimen of this magnificent insect is before me. It differs from *E. gigas* (the largest species hitherto known) in being much larger, more parallel-sided, and with the prothoracic markings longitudinal instead of transverse; the marking on each side is constricted in the middle, and towards the apex becomes dilated, and then subrounded; towards the base it is strongly bifurcated; the middle is occupied by a black angular patch which is strongly narrowed towards the apex and less strongly to the base; on each side of the base there is a black angular projection. The prothorax also is without the patch of large basal punctures on each side. The humeral markings are not connected as in *E. gigas;* and the subapical spot on each elytron is smaller and more rounded. The scutellum is also more transverse. The subtriangular extension of the front tibiæ is probably sexual. In some lights, the antennæ and front legs appear to be feebly diluted with red.

EPISCAPHULA GIGAS Macl. (Plate xvii., fig. 11).

A sketch of the markings of this species is given for comparison with those of *E. hercules.*

EXPLANATION OF PLATE XVII.

Fig. 1.—*Palimbolus mamillatus* Lea; hind leg.
Fig. 2.—*Collacerothorax sculpticeps* Lea.
Fig. 3.—*C. sculpticeps*; side-view of head.
Fig. 4.—*C. sculpticeps*; base of head, from behind.
Fig. 5.—*Rytus insignicornis* Lea.
Fig. 6.—*Chlorobapta tibialis* Lea.
Fig. 7.—*Hylecœtus fuscipennis* Lea.
Fig. 8.—*H. vigilans* Lea; head and prothorax.
Fig. 9.—*Typhluloma inops* Lea.
Fig. 10.—*Episcaphula hercules* Lea.
Fig. 11.—*E. gigas* Macl.; markings.

THE HÆMATOZOA OF AUSTRALIAN REPTILIA.
No. ii.*

By T. Harvey Johnston, M.A., D.Sc., and J. Burton Cleland, M.D., Ch.M.

(From the Bureau of Microbiology, Sydney.)

(Plates xiii.-xvi.)

In the present paper we propose to deal with a number of parasites found by us in reptilian blood-smears, for the greater number of which, we are indebted to the kindness of Dr. T. L. Bancroft, of Eidsvold, Burnett River, Queensland. Type-slides of those forms which we consider to be new to science, have been deposited in the Australian Museum, Sydney.

In addition to the parasites described below, we have met with Trypanosomes and Hæmogregarines in films taken from a skink-lizard, *Lygosoma tæniolatum* White, by Dr. Bancroft (Burnett River district; February, 1911).

Our thanks are due to Dr. T. L. Bancroft and Dr. H. G. Chapman, for forwarding material; to Messrs. A. McCulloch and D. Fry, of the Australian Museum, for identifying specimens for us; and to Mr. W. A. Birmingham, of this Bureau, who has drawn the figures in the accompanying plates from our original camera lucida drawings.

Trypanosoma chelodina Johnson.

(Plate xiii., figs.1-14.)

This hæmoflagellate was described by Dr. A. E. Johnson (1907, p. 26), as occurring in the Murray River Tortoise, *Chelodina longicollis*. The species usually called the Murray

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* Continued from these Proceedings, 1910, xxxv., pp.677-685.

Tortoise is *Emydura macquariæ*, which is somewhat like *C. longicollis*. The latter, however, is a widespread species inhabiting the whole of the Southern and South-East portions of Australia, as well as extending northwards into Queensland. The account is very brief and unfigured, and, moreover, the measurements appear to be incorrect. We have met with the same parasite in *Emydura krefftii*, in smears sent down from Queensland by Dr. Bancroft, who made the films from two animals, one captured at Petrie's Creek (April, 1910), and the other in the Burnett River recently (January, 1911), as well as in a film from *C. longicollis*, also forwarded recently by him (Burnett River).

A comparison of our forms with the account given of *T. chelodina*, showed us that the only difference was that of size. It was noticed that, in this account, though the parasites were said to be larger than the erythrocytes, yet the dimensions given were very much smaller. In order to satisfy ourselves as to the correctness, Dr. H. G. Chapman kindly allowed us to compare our types with those present in a film sent to him by Dr. Johnson. In addition to the Trypanosome, the latter film contained hæmogregarines, similar to the forms referred to by us elsewhere.

Some figures from the Murray River Tortoise, as well as from *Emydura krefftii*, are given. The parasite possessed a fairly constant form, pleomorphism not being detected. The length (excluding the short flagellum) varied from 39-43 μ (14 μ in the original account), and the flagellum was very short, being from 3-6 μ long (2 μ in the original). The breadth of the body of the flagellate, measuring in the region of the nucleus, excluding the undulating membrane, was from 3-5·5 μ (1·5 μ in Johnson), while the undulating membrane varied from 1·5-3·3 μ in width. The maximum breadth was thus from 5-8·5 μ. The anterior end was long and narrow, ending acutely, and consequently the point of junction with the short flagellum was not always distinguishable. The main mass of the body was of a fairly uniform breadth, but tapering rapidly at the posterior end. The protoplasm, except at the posterior end, where it was only slightly coloured, was stained a deep blue. It appeared to be homogeneous in most specimens, though a few large vacuoles were seen in others. Granules were sometimes seen in the clearer area at the posterior end. Lying in this region, was the kinetonucleus, which is situated at about one-third of the distance between the end and the centre, the large rounded nucleus lying some little distance posteriorly from the centre. The undulating membrane was a rather wide, lightly staining structure possessing a folded edge.

The measurements of some typical forms are given below. Nos. i. to v. from *Emydura krefftii* (Queensland), and Nos. vi. and vii., from *Chelodina longicollis* (South Australia). The sizes are given in micromillimetres.

	i.	ii.	iii.	iv.	v.	vi.	vii.
Posterior end to kinetonucleus........	5	7	8	6	8	7	6·5
Kinetonucleus to edge of nucleus ..	12	11	10	10	11	10	10
Length of nucleus	3·5	3·5	3·5	3	3·5	4·5	4
Nucleus to anterior end................	20	21	18·5	20·5	20	21·5	20
Free flagellum	6	—	3	3	—	3·5	3·5
Total length (including flagellum)...	46·5	42·5	43	42·5	42·5	46·5	44
Total length (excluding flagellum)...	40·5	42·5	40	39·5	42·5	43	40·5
Greatest width	6·5	6·5	5	6·5	6	8	8·5
Breadth of "body" opposite nucleus	4·5	4	3	4	3·5	5·5	5
Breadth of undulating membrane....	2	2·5	2	2·5	2·5	2·5	3·5

HÆMOCYSTIDIUM CHELODINÆ, from *Emydura krefftii* Gray.

(Plate xiii., figs.15-21.)

Dr. Bancroft kindly sent to us two blood-films taken during April, 1910, from the freshwater-tortoise, *Emydura krefftii* Gray, one taken at Enoggera, and the other at Petrie's Creek, Queensland. An examination showed that the tortoise from the latter locality was parasitised by hæmatozoa. We were surprised at finding that the animal's blood harboured no less than three quite different parasites, namely, a Trypanosome (*T. chelodina*), a Hæmogregarine (*H. clelandi*), and a Hæmocystidium (Johnston and Cleland, 1910, p. 679). We have identified the last-mentioned as being specifically identical with *H. chelodinæ,* already described by us (1909, p. 97) from another tortoise, *Chelodina longicollis* Shaw, from the Sydney district. We have also seen a few parasites belonging to this species in a Western Australian representative, *Chelodina oblonga,* taken near Perth.

The parasites varied in size from 6·5 × 5·5 μ to 12·5 × 10 μ, the average size being about 11 × 8 μ. A few forms were practically circular in outline, but most of them were elliptical or of a distorted reniform shape. In all cases observed, the position occupied was between the nucleus and one end of the cell. There were two types of the hæmatozoon present. Some of the organisms when stained with Giemsa, were coloured a uniform and fairly deep blue. In these parasites, no nucleus was recognisable. Others were very lightly stained, and, in these, a more or less definite and rounded, large purplish nucleus was seen lying centrally. These cells possessed rather larger melanin-granules than the more deeply staining forms. Two vacuoles were usually present, but their position was variable. The melanin-granules were relatively thick and abundant. More usually they were mainly aggregated near the mid-region, but a number were peripherally situated. In some cases, the arrangement was quite irregular, the individual grains remaining isolated. The host-cell was not in any way distorted, nor was its nucleus displaced.

HÆMOGREGARINA CLELANDI Jnstn.

(Plate xiv., figs. 1-25).

This hæmatozoon was originally described (Johnston, 1909, p. 407) from the West Australian tortoise, *Chelodina oblonga.* We have since found it in *Emydura krefftii* and *Chelodina longicollis.* Films were forwarded to us in April, 1910, by Dr. T. L. Bancroft, who took the smears from two of the former species, one at Petrie's Creek, and the other at Enoggera, Queensland. The specimen from Petrie's Creek showed, as already mentioned, the presence of three different types of hæmatozoa, including the above hæmogregarine. The other film was negative. Films taken from the same species in September and in October, 1910, in the Burnett River, by Dr. Bancroft, were forwarded to us; and, on examination, the former was found to contain *Trypanosoma chelodina*, as well as the above hæmogregarine, whereas in those of the latter date, only a few hæmosporidia were detected. The same parasite was found in films taken from a long-necked tortoise, *Chelodina longicollis*, by the same gentleman (Burnett River). We have also recognised as belonging to the same species, the hæmogregarines present in films taken from this tortoise by Dr. Angas Johnson (Murray River, South Australia). The latter films also contained the trypanosome described by him (1907, p. 26) as *Trypanosoma chelodina*, and were forwarded to Dr. H. G. Chapman, who kindly allowed us to compare our trypanosomes with those present on this slide.

The hæmogregarines were variable in size, those from the *Chelodina longicollis* from Queensland being small, averaging about 10 × 5·3 μ. The longest forms detected, were found in the same species from the Murray River, some reaching 17 μ in length × 6 μ in breadth. The broadest parasite seen by us, was found in *Chelodina oblonga*, and measured 16·5 μ in length by 7·8 μ in breadth. The smallest and youngest form noticed, was only 5 μ long and under 1 μ in maximum breadth. It was club-like, one end being narrow and tapering, the other broad and rounded. It was seen in *Chelodina longicollis*.

The general form of the hæmogregarine was elliptical or reniform, possessing a fairly regular outline. In such cases, the ends were alike, though the nucleus usually approximated towards one extremity, the posterior. In a few parasites, a well-marked "tail" was present, lying bent round so as to be parallel to the main part of the "body."

The protoplasm became stained a pale blue on using Giemsa's stain, there being an appearance of vacuolation in some of the specimens. The nucleus was very varied in form and position. In young members, it appeared as a dense, deeply staining mass lying medially. In others, the chromatic material was more or less irregularly aggregated near the middle, but usually just behind it. Sometimes the form was distinctly bandlike, while frequently the chromatin was dispersed peripherally, no nuclear substance being detected in the hind-region of the parasite. A horseshoe-shaped nucleus was not uncommon. In all except quite young forms, a distinct capsule was present. It usually invested the hæmogregarine very closely, but occasionally there was a moderate interval between them.

The parasite occupied various situations in the host-cell, but, in nearly all cases, its general position was parallel to the longitudinal axis of the erythrocyte, the host-nucleus lying between the end of the parasite and the end of the cell. Sometimes the host-nucleus lay between the parasite and the side of the cell. Occasionally the hæmogregarine was situated transversely in the red blood-cell. In regard to the effect on the red corpuscle, in addition to the nuclear displacement just referred to, which usually takes place, there is generally a slight increase in the size of the host-cell. However, the influence of the parasite does not seem to be considerable, when compared with what may happen in the case of certain other reptilian hæmogregarines.

A typical slide containing *Hæmogregarina clelandi* and *Trypanosoma chelodina* from *Emydura krefftii*, has been deposited in the Australian Museum, Sydney.

HÆMOGREGARINA TILIQUÆ, n.sp.

(Plate xv., figs. 6-15.)

In a specimen of *Tiliqua scincoides*, obtained near Sydney, in October, 1910, hæmogregarines were fairly numerous in the red cells. The adult parasites exhibited the usual hæmogregarine form with one end broad, narrowing thence towards the other end, and then bending around sharply to form a narrowed tail bent in upon the body. The surrounding capsule was easily recognisable in some forms. The affected red cells were slightly distorted, and their nuclei pushed to one side and elongated. The longest parasite was 20·5 μ × 3·5 to 1·7 μ. The length varied from 13-20·5 μ, the breadth in the widest portion of the organisms being about 4 μ. The staining of the body was a more or less deep blue, and, by Giemsa's stain, the chromatin presented different appearances in different specimens. In one, for instance, the body, as far as the bend, was occupied by broad, reticulated, chromatin-like bands surrounded at the periphery of the animal by the blue protoplasm. In another specimen, the chromatin staining appeared as masses of purplish granules on a deep blue base, one mass occupying the broad end, another in the centre, and a few granules the bend.

In addition to these adult stages of the parasite, numerous early forms were seen, which were more or less spherical, and varied in size from 4-7 × 4·5 μ. These bodies occupied various positions in the host-cell, sometimes being between the nucleus and the side of the cell, sometimes just at or beyond one end of the host-nucleus, sometimes right on one end of the host-cell and pushing the nucleus to the other end. In one cell, two of these bodies were seen, spherical in shape, of about 3·5 μ diameter, and occupying positions at opposite ends of the host-nucleus. In the earlier stages, these bodies may appear as a deep purple ring, with a clear centre, containing some minute purple specks, or they may be evenly stained (a deep blue), or they may appear as a deep blue, peripheral, thick ring with a pale blue interior containing minute purple specks. In one film, a number of free, slightly curved forms were detected. These were 9 μ in length, and about 2 μ in breadth, possessing a blunt anterior end, the body generally tapering posteriorly for a little distance, and then becoming rapidly narrowed to end in a thin tail.

HÆMOGREGARINA (KARYOLYSUS) BANCROFTI, n.sp.

(Plate xv., figs. 16-24.)

Dr. Bancroft forwarded some blood-smears from two snakes, *Pseudechis mortonensis* De Vis, and *P. australis* Gray, killed in the Burnett River district in January and March respectively. These, on examination, were seen to be parasitised by a hæmogregarine, which differs considerably from those previously seen by us. We have accordingly described it as a new form, associating with it the name of Dr. Bancroft, who has rendered us such generous assistance in regard to material.

The parasite resembles *H. megalocystis* (Gilruth, Sweet, and Dodd, 1910, p.234), from *Python variegatus*, in its effect on the host-cell. There is very marked increase in the size of the latter, its protoplasm becoming very thin and dehæmoglobinised. Not infrequently, the cell-outlines become so faint as to be unrecognisable. Sometimes the stroma (or portion of it) of the host-cell remains surrounding the parasite and the host-nucleus, the latter being only slightly displaced laterally. Normal cells are from 15-19 μ in length × 10-11 μ in breadth, whilst infected cells may reach 31·5 × 17·5 μ. The parasite lies at about the middle of the erythrocyte, with its concavity partly surrounding the host-nucleus, which does not seem to be detrimentally affected, though the stroma becomes profoundly altered. The amount of alteration is not dependent on the size of the hæmatozoon contained within the cell. No definite capsule enclosing the parasite was recognised, except in one case, where it was seen to invest the organism very closely.

The hæmogregarines are relatively small, measuring from 10-17 μ long, by about 3 μ broad, and of a fairly regular form and even breadth, as will be seen from the figures. A few broader forms were seen, these measuring about 5 μ in width. The ends were usually similar. The nucleus was sometimes near one end, at other times it was centrally situated. The protoplasm of the parasite was very faintly stained, and, at times, large vacuoles were seen.

The parasite in question is seen to be markedly different from *H. pseudechis* from the allied species of snake, *Pseudechis porphyriacus.*

HÆMOGREGARINA (KARYOLYSUS) HINULIÆ Jnstn. & Clel.

This protozoon has again been detected in *Lygosoma* (*Hinulia*) *quoyi*, the lizard being found in the Sydney district.

HÆMOGREGARINA (KARYOLYSUS) PSEUDECHIS Jnstn.

(Plate xv., figs. 1-5.)

A black snake, *Pseudechis porphyriacus*, killed on Milson Island, in the Hawkesbury River, was found to be parasitised by the above-named hæmatozoon. Most of the forms detected were longer and thinner than those previously figured(Johnston, 1909, p. 406).

HÆMOGREGARINA SHATTOCKI Samb. & Selig.

Films taken from a carpet-snake, *Python variegatus*, in October, 1910, and from another, in February, 1911, by Dr. T. L. Bancroft, who captured these animals on the Burnett River, showed the presence of hæmogregarines belonging to the above-named species (Johnston, 1909, p. 402). Another hæmatozoon, *H.* (*Karyolysus*) *megalocystis*, has recently been described from this host in Victoria (Gilruth, Sweet, and Dodd, 1910, p. 683).

HÆMOGREGARINA VARANICOLA Jnstn. & Clel.

(Plate xvi., figs. 11-20).

We have seen this parasite in films taken from three specimens of *Varanus varius* by Dr. T. L. Bancroft, in October, November, and December, 1910, in the Burnett River district. The characters of the hæmogregarine were similar to those already described by us (1910, p. 683; Gilruth, 1910, p. 36). A goodly number of hæmogregarines have been observed in different species of *Varanus*, from various parts of Africa, and from India (Simond, 1901; Laveran, 1905; Nicolle and Comte, 1906; Bouet, 1909; Laveran and Petit, 1909; Franca, 1910, p. 203).

HÆMOGREGARINA (KARYOLYSUS) GOULDII, n.sp.

(Plate xvi., figs. 1-10.)

The hæmogregarines present in films taken from two specimens of *Varanus gouldii* by Dr. Bancroft (Burnett River, October, 1910; March, 1911), appear to us to differ from those found in *Varanus varius* in the same district, and at the same time of the year. The parasite has a more detrimental effect on the host-cell than *H. varanicola* appears to have. In practically all cases, the nucleus of the infected erythrocyte was seen to be considerably elongated, the hæmatozoon, as a rule, either lying close beside it or else overlying it. Sometimes a certain amount of dehæmoglobinisation and generally more or less elongation of the host-cell occurred. In greatly distorted erythrocytes, little or no hæmoglobin remained, the host-protoplasm being very thin. A capsule, when recognised, was seen to surround the parasite very closely.

Most of the hæmogregarines were rather thin, elongate bodies (about 20 × 2·5 μ) investing the host-nucleus somewhat as a Halteridium does. In these forms, the nucleus was dense and deeply staining; and, in addition, there was usually an abundance of small chromatic granules dispersed throughout the protoplasm. A second type of organism was also present, the body being broader and more plump (10·8-17 μ long, × 5·7 μ broad), and the nuclear matter rather more dispersed and less deeply staining. Besides, the protoplasm stained very lightly, being vacuolate. Chromatic specks were usually not so abundant, and frequently were absent. These two types may represent the sexual forms referred to by Prowazek (1907, p. 32).

MICROFILARIA SP.

(Plate xvi., fig. 21).

Filarial embryos were found in blood-films from a water-lizard, *Physignathus lesueurii*, kindly forwarded to us by Dr. T. L. Bancroft, who captured it in the Burnett River, Queensland, in December, 1910. The adults were not looked for, as the presence of the microfilariæ was not suspected.

The general appearance of the embryos is as follows:—the anterior four-fifths of the body is of a uniform breadth, the remainder tapering gradually, to end rather abruptly in a rounded extremity. The anterior end is broad and rounded. No definite transverse striation could be detected on the very delicate cuticle. A sheath is present. The main mass of cells stain very deeply with Giemsa, a few small, scattered masses occurring close to the anterior end. The various "spots" or "breaks" are situated at intervals; the first, the nerve-ring, lying near the junction of the anterior two-fifths with the posterior three-fifths; the second, the excretory vesicle, lying midway between the nerve-ring and the posterior extremity; and the third, the "anal spot," appearing as a broad zone a little distance in front of the tail. The first and second spots may be situated further back, and the third may be rather long, with a few isolated cell-masses in the middle of it. Behind the anal region, the cell-mass extends backwards to the end of the worm. The embryos are about 4·5 μ broad, and from 118-143 μ long.

Very few filariæ appear to have been recorded from the blood of lizards, no record of their having been found previously in Australian lacertilians, being known to us. In 1904, Castellani and Willey (1904, p. 79) referred to a filaria (which they called *F. mansoni*) from a Ceylonese lizard, *Mabuia carinata* Schn. As this name was preoccupied by Cobbold in 1880, Linstow (1908, p. 172) renamed it *F. tuberosa*, giving a short account of the adult, which was found in the peritoneum. He merely mentioned that the larvæ occurred in the blood. Rodhain (1906, p. 545) found embryos in the blood of an African lizard, *Agama colonorum*, the adults occurring in the subcuticular tissues. Only the larvæ were described, the name *F. agamæ* being used. Wenyon (1908, p. 165) referred to finding microfilariæ in the same species from the Soudan, Leiper (1908, p. 191) adding a few details. Prowazek (1907, p. 35),* in a footnote to a paper on a Hæmogregarine from a gecko, *Platydactylus guttatus* Cuv., from Batavia, mentioned that, in addition to the hæmoprotozoon, he had found nematode larvæ in the blood, the adults being found encapsuled in the peritoneum, in the liver, and under the skin. These larvæ were said to be similar to those found by Rodhain.

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EXPLANATION OF PLATES XIII.-XVI.

Plate xiii.

Figs. 1-10.—*Trypanosoma chelodina* from *Emydura krefftii.*
Figs. 11-12.—*Trypanosoma chelodina* from *Chelodina longicollis* (Queensland).
Figs. 13-14.—*Trypanosoma chelodina* from *Chelodina longicollis* (South Australia).
Figs. 15-20.—*Hæmocystidium chelodinæ* from *Emydura krefftii.*
Fig. 21.—*Hæmocystidium chelodinæ* from *Chelodina oblonga.*

Plate xiv.

Fig. 1.—Normal erythrocyte of *Chelodina longicollis.*
Figs. 2-6.—*Hæmogregarina clelandi* from *C. longicollis* (Queensland).
Figs. 7-9.—*Hæmogregarina clelandi* from *C. longicollis* (South Australia).
Figs. 10-13.—*Hæmogregarina clelandi* from *C. oblonga* (West Australia).
Fig. 14.—Normal erythrocyte of *C. oblonga.*
Figs. 15-25.—*H. clelandi* in blood-cells of *Emydura krefftii.*

Plate xv.

Fig. 1.—Normal erythrocyte of *Pseudechis porphyriacus.*
Figs. 2-5.—*Hæmogregarina pseudechis.*
Figs. 6, 8-15.—*H. tiliquæ* from *Tiliqua scincoides.*
Fig 7.—Normal erythrocyte of *T. scincoides.*
Figs. 16-17.—Normal erythrocytes of *Pseudechis australis.*
Figs. 18-24.—*H. bancrofti* from *Pseudechis australis.*

Plate xvi.

Fig. 1.—Normal erythrocyte of *Varanus gouldii.*
Figs. 2-10.—*Hæmogregarina gouldii* from *V. gouldii.*
Fig. 11.—Normal erythrocyte of *V. varius.*
Figs. 12-20.—*H. varanicola* from *V. varius.*
Fig. 21.—*Microfilaria* from *Physignathus lesueurii.*
Fig. 22.—Normal erythrocyte of *P. lesueurii.*

(All the above figures have been drawn, using the same magnification.)

CONTRIBUTIONS TO OUR KNOWLEDGE OF SOIL FERTILITY.

ii. *The Determination of Rhizobia in the Soil.*

BY R. GREIG-SMITH, D.SC., MACLEAY BACTERIOLOGIST TO THE SOCIETY.

It has been recognised by bacteriologists that the actual number of bacteria in any particular soil is no criterion of the fertility, for the kinds of bacteria that are included in the total number may be of little use in bringing about the multifarious changes that go to determine the value of the soil. The bacteria that bring about the comparatively rapid transformation of the constituents, or which have some specific activity, are alone of immediate importance; and, as it is these only which determine the economic bacterial potential, the number of the others is of little or no interest.

Selective methods of ascertaining the extent of these kinds are, therefore, important, and various methods have been devised with this object in view. These take into account the physiological activity, and are really chemical tests, inasmuch as the soil is seeded into solutions of various forms of saline and organic substances, and the chemical changes determined. By using graduated dilutions of soil suspension, one obtains a point where no change occurs, and this marks the limit of the presence of certain active organisms. Such is the method of Hiltner and Störmer. There are certain objections to this method, the chief of which is that, under the unnatural conditions which obtain, the active bacteria may possibly be suppressed by inactive forms.

At the present time, the micro-organism to which the chief rôle of the non-symbiotic fixation of nitrogen in the soil is ascribed, is *Azotobacter chroococcum*, discovered by Beijerinck in 1901. It is known that other soil-bacteria have also the power, and possibly chief among these is *Rhizobium leguminosarum*, which, as I have shown,[*] ought to find in soil a medium well adapted to its growth and activities. It is also known that, in artificial culture, it may be very little less active than *Azotobacter* in its characteristic power.[†]

I am not aware that any definite experiments have been made to determine the actual numbers of *Azotobacter* or of *Rhizobium* in soil, beyond those of Löhnis; and it appears that this is an important matter, because the chief rôle can only be credited to *Azotobacter*, if it is found that this organism is at least half as numerous as *Rhizobium*. Löhnis[‡] found but a small number of nitrogen-fixing microbes in a gram of soil, and it may be on this account that so little attention has been given to the possibility of organisms other than *Azotobacter* being chiefly responsible for the fixation that occurs in soil.

If it can be shown that there are as many as two millions and a half of nitrogen-fixing bacteria other than *Azotobacter* in a gram of soil, our ideas with regard to the active agent must undergo a complete change. This is what I have found in certain soils.

The research originated in the desire to obtain a selective medium for demonstrating the number of *Azotobacter* in soil, but it immediately became apparent that the most numerous nitrogen-gatherer was *Rhizobium*. Indeed, in all the work with agar-media herein described, *Azotobacter* was only twice found. I am aware that the enumeration of *Rhizobia* in soil will, if the method be speedy and convenient, only give another factor, although an important one, in arriving at the value of a soil.

Bearing in mind the selective media used in other domains of bacteriology for isolating certain species, I tried various nutrients in combination, and found the best to be a medium containing levulose, asparagin, and citrate. To improve this, I tried some

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[*] These Proceedings, 1906, pp.283, 286.

[†] *Ibid.* 1906, pp.608, 618.

[‡] Löhnis, Centralbl. f. Bakt. 2te Abt. xii.(1904), 459.

40 stains in conjunction with the agar-medium, but while, at first, the most promising appeared to methyl-violet, crystal-violet, and malachite-green, which are used for suppressing acid-forming bacteria such as *Bac. coli*, later work showed that the stains were of little advantage.

The first four experiments which I give, were made with a medium containing a trace of crystal-violet, but a test-plate in Expt. iv. showed that the addition was absolutely unnecessary, and, in the later experiments, it was not used. The medium in its final form was as follows:—

Levulose	2 grm.
Asparagin	0·06 grm.
Sodium citrate	0·1 grm.
Potassium citrate	0·1 grm.
Agar	2 grm.
Tap-water	100 c.c.

The medium allows a free development of *Rhizobium*, and hinders the great majority of the other bacteria and moulds. So much is this the case that, in some instances, plates have been obtained with over 50% of the colonies consisting of *Rhizobium*. Generally a huge bacterium of the *subtilis*-type is present on the plates; but the colonies of this grow to a much larger size, and can be readily differentiated by observing the edge with a low magnification. The small or punctiform white, somewhat stiff, gummy colonies of *Rhizobium* have a finely granular structure, smooth edge, and brown colour under a magnification of 100. Films show cells of varying size according to the colony, and generally have the irregular outline and structure suggesting a sausage-skin stuffed more or less with marbles; and although the γ and Y forms were rare, the exclamation mark(!), the irregularly divided rod, and the club-shaped forms were quite numerous. The speed of identification can be accelerated by preparing a series of twelve films upon a single 3 × 1 inch slide which has been flamed to expel traces of grease.

In many cases, the bacteria are seen lying in patches suggesting zooglœa-films, and the bulk of the cells stain faintly with aqueous gentian-violet, a few staining deeply. This is rather characteristic, and, in cases of doubt, aids the positive diagnosis which, however, requires confirmation by growing the bacteria as giant colonies on plates of nutrient agar, and agar with a plant-extract, *e.g.*, beans as a basis. One can generally plant about 24 of such colonies upon a single agar-plate, the under-side of which has been divided and numbered with a grease-pencil. In preparing the plates, suspensions of the bacteria are obtained by shaking quantities of the soil, varying with the suspected *Rhizobium*-content, with 500 c.c. of sterile tap-water for half an hour: from these, dilutions are made. Of each of these dilutions, one-fortieth c.c. is measured in a capillary pipette, and blown upon the agar-plates, smeared, dried at 37° for an hour, inverted, and incubated at 22° for 5-7 days.

The preliminary experiments were made with a rich, and a poor Hawkesbury soil, and also a sandy garden (Sydney) soil. In these, the numbers of *Rhizobia* were 600,000, 24,000, and 350,000 respectively, in a gram of air-dried soil. The result of the preliminary experiment was so satisfactory, that I obtained five soils of known history from the Hawkesbury Agricultural College through the kindness of the Principal, Mr. H. W. Potts, and employed them in the investigations. In Expt. i., the medium, which originally had an acidity of + 1, was reduced to + 0·4, by the addition of three drops of normal soda per 10c.c. In Expt. ii., the influence of the reaction was tested, largely with the idea of duplicating the tests; and the results showed that the reaction was of importance, and was worthy of investigation.

EXPERIMENT i.

	Rhizobia in 1 grm. of dry soil.
No. 1.	1,246,000
No. 2.	123,000
No. 3.	162,000
No. 4.	0
No. 5.	1,515,000

EXPERIMENT ii.

	Quantity of air-dried soil added to 500 c.c. then 2 c.c. to 98 c c.	*Rhizobium*-colonies on plates.	*Rhizobia* in 1 grm. of dry soil.		
			Reaction*		
			+0·2	-0·2	-0·6
No. 1	5 grm.	9 - 5 - 3	1,870,000	1,040,000	620,000
No. 2	25 grm.	1 - 2 - 1	†41,000	82,000	41,000
No. 3	50 grm.	7 - 5 - 2	140,000	101,000	40,000
No. 4	125 grm.	0 - 0 0	0	0	0
No. 5	5 grm.	4 - 3 - 1	812,000	690,000	230,000

† Also *Azotobacter*, 1 colony = 41,000 per gram.

* The reaction of the medium as prepared was such that 10 c.c. had an acidity = +1 of Fuller's scale, *i.e.*, 100 c.c contained the equivalent of 1 c c. of N/1 acid. The capillary pipette, which was used for neutralising or augmenting the acidity, was of such calibre that 50 drops = 1 c.c. The addition of 1 drop of N/1 carbonate of soda to 10 c.c. of medium changed the reaction from +1 to +0·8.

EXPERIMENT iii.

	Rhizobium-colonies on plates.	*Rhizobia* in 1 grm. of dry soil.			
		Reaction of medium.			
		+0	+0·4	+0·8	+1·2
No. 1	1—10—13—0	208,000	2,080,000	2,704,000	0
No. 2	0—1—4	0	41,000	164,000	—
No. 3	0—6—8	0	126,000	162,000	—
No. 4	0—0—0	0	0	0	—
No. 5	0—5—8—0	0	1,015,000	1,624,000	0

EXPERIMENT iv.

	Rhizobia in 1 grm. of dry soil.		
	Reaction of medium		
	With addition of soda		Without soda
	+0·5	+0·8	+1
No. 1....	2,288,000	2,704,000	0
No. 2...............	206,000	41,000	0
No. 3.............. ..	485,000	424,000	0
No. 5............ ...	913,000	1,015,000	0
No. 1 (no violet)...	3,744,000	3,536,000	0

In Expt. iv., tests were made in which the natural acidity of + 1 was augmented by the addition of phosphoric acid in quantity to produce acidities of from + 1·2 to + 2·4, but no colonies were obtained. From the consideration of Expts. iii. and iv., it is evident that, unless carbonate of soda is added, there is no growth, and that the addition of even one drop causes the medium to be exceedingly favourable to the growth of *Rhizobia*.

The higher numbers obtained in the absence of methyl-violet in Expt. iv., led to a set being tested without it. The result showed that its addition was unnecessary, and it was not used again.

EXPERIMENT V.

	Rhizobia in 1 grm. of dry soil.
	Reaction = + 0·6.
Soil 1	2,288,000
Soil 2	227,000
Soil 3	202,000
Soil 5	812,000

A series of plates with increasing amounts of normal phosphoric acid and of carbonate of soda was prepared, and smeared with suspensions of soil No. 1. The plates containing the acid were sterile, and are not recorded.

EXPERIMENT vi.

No.	Colonies on the plates.			Drops of N/1 soda(= 1/50 c.c.) added to 10 c.c. medium.	Reaction.	*Rhizobia* in 1 grm. dry soil.
	Moulds.	Total Bacteria.	*Rhizobia*.			
1	5	6	0	0	+ 0·6	0
2	6	6	3	1	+ 0·4	1,248,000
3	7	24	13	2	+ 0·2	5,408,000
4	4	16	11	3	0	4,526,000
5	4	15	6	4	− 0·2	2,496,000
6	2	18	13	5	− 0·4	5,408,000
7	2	17	10	8	− 1·0	4,160,000
8	1	7	6	11	− 1·6	2,496,000
9	2	0	0	15	− 2·4	0

No. 5 of the series is apparently accidentally low, and an allowance should be made for it Variations in the reaction of the medium do not appear to have much influence upon the growth of Rhizobial forms, so long as the small quantity of soda is added *just before the plates are poured.* The addition of the soda to the bulk of the medium in its preparation, has no influence in assisting the growth of the bacteria. This curious time-effect is seen when Expt. iv. is compared with Expt. vi.

THE INFLUENCE OF CARBONATE OF SODA.

	Drops of N/1 soda added to 10 c.c.	Final Reaction.	*Rhizobia* per gram of soil.
Expt. iv.	None	+1·0	0
	One when pouring plate	+0·8	2,704,000
	Three when pouring plate	+0·4	2,288,000
Expt. vi.	Two when preparing medium	+0·6	0
	One when pouring plate	+0·4	1,248,000
	Two when pouring plate	+0·2	5,408,000

When the soda is added to the molten agar just before pouring the plates, the medium becomes so selective as to be almost specific. On the plates of Expt. vi., which is typical of the previous experiments, the Rhizobial colonies constituted from 33% to 86% of the bacterial colonies.

Experiment vi. was repeated with the following results:—

EXPERIMENT vii.

Drops of soda added to 10 c.c. of medium.	Reaction.	*Rhizobia.*	
		On plate.	in 1 grm. dry soil.
0	+0·6	0	0
1	+0·4	3	1,248,000
2	+0·2	4	1,664,000
3	0	4	1,664,000
4	−0·2	3	1,248,000
5	−0·4	7	2,912,000
6	−0·6	4	1,664,000
7	−0·8	2	816,000
8	−1·0	6	2,496,000

It is evident that a considerable variation may occur in the tests, and the only method of arriving at a satisfactory conclusion with regard to the optimum number of drops of soda to add, would be to average several experiments conducted with this object in view.

When this is done with Expts. vi. and vii., it is found that the highest figures are obtained when from three to five drops (each = 1/50 c.c.) of normal soda are added to 10 c.c. of molten agar-medium just before pouring the plates.

EXPERIMENT viii.

Drops of soda added.	Reaction.	Colonies on the plates			*Rhizobia* in 1 grm. dry soil.
		Moulds.	Total Bacteria.	*Rhizobia.*	
0	+0·6	12	3	2	832,000
,,	,,	6	6	2	832,000
1	+0·4	1	18	13	5,408,000
,,	,,	4	6	5	2,080,000
3	0	4	8	3	1,248,000
,,	,,	3	6	4	1,664,000
5	−0·4	0	10	5	2,080,000
,,	,,	2	4	3	1,248,000
7	−0·8	2	4	0	0
,,	,,	3	4	2	832,000
9	−1·2	11	0	0	0
,,	,,	4	2	0	0

These duplicates are portions of one suspension, and were abstracted at the same time. The divergence between them shows why the results of the previous tests have been so varied. A uniform suspension is apparently very difficult to obtain. The difference in the duplicates of (1) is an exceptional case, but as it has occurred, a similar divergence may occur again. As these were portions of one suspension, it is evident that the distribution of the bacteria is most irregular. It is possible that a clump of bacteria may get broken up during the process of pipetting out the portion, and smearing the plate. The occasional grouping of colonies shows that the latter does occur.

The soils were again examined, using a medium made neutral with three drops of soda.

EXPERIMENT ix.

	Colonies on the plates.			*Rhizobia* in 1 grm. of dry soil.
	Moulds.	Total Bacteria.	*Rhizobia.*	
Soil 1	4	8	3	1,248,000
,, ,, ...	3	6	4	1,664,000
,, 2	5	21	0	0
,, 3	8	8	0	0
,, ,, ...	4	7	0	0
,, ,, ...	13	9	0	0
,, 4	64	2	0	0
,, ,, ...	60	6	0	0
,, 5	9	7	1	135,000
,, ,, ...	9	4	0	0
Garden.........	17	20	18	273,000
,, ...	9	36	10	210,000

The results are much lower than those obtained in previous experiments, and, as the method of isolation had presumably been improved, it was thought that the shrinkage might have been caused by the bacteria slowly dying out during the four months that the soils had been stored in the laboratory. Storage, however, appears to affect them only to a slight degree; when new soils were tested, the results did not show any pronounced loss.

EXPERIMENT x.

	Rhizobia per gram of soil.		
	Stored 2 days.	Stored 17 days.	Stored 27 days.
Soil No. 1.........	1,632,000	1,124,000	1,428,000
Soil No. 4.........	16,160	6,060	6,060
Orchard soil......	1,200,000	—	—

So far as the soils are concerned, a certain amount of information might be gained by collecting the various results, and making an average. As the conditions were the same for each set, the averaging will probably minimise the experimental error. The averages of eleven counts were taken from Expts. i., ii., iii., iv., v., and ix., and are given in the following table, which also includes the notes and fertility numbers* that accompanied the soils.

Notes upon the Soils.		Fertility maximum = 10.	Average number of *Rhizobia* in 1 grm. of dry soil.	Ratio of *Rhizobia*.
Number	Nature.			
1	A fairly rich alluvial soil	8	1,741,000	20
2	A virgin soil taken 20 yards from No.1	–	88,000	1
3	A poor sandy soil; grew tares last season from infected seed	2	167,000	2
4	Obtained three yards from No.3; also grew tares, but was not inoculated; crop was not so good as on No.3	2	0	0
5	Soil of experimental plots	5	796,000	9

There is, to a certain extent, a parallel between the fertility and the number of *Rhizobia* in the soil, and if we omit the virgin soil and No.4, which is exceptional in other ways, the numbers expressing the ratios are virtually the same. Thus, so far as we know, the number of *Rhizobia* in agricultural soils is proportional to the fertility.

The effect of cultivation in increasing the numbers of *Rhizobia* is shown in Nos.1 and 2; the soil of No.4 was subsequently found to be very toxic, and this probably accounts for the absence of *Rhizobia*. It improved greatly after heavy rains.

The main object of the research, however, was the preparation of a medium selective enough to enable the *Rhizobia* to be determined, and this has been done. These *Rhizobia* are presumably nitrogen-gatherers. On several occasions, the bacteria were tested to see if they were nitrogen-destroyers, such as is *Vibrio denitrificans*, but no evolution of gas in nitrate bouillon was ever observed. Finally, the nitrogen-fixing power was determined in order to make certain that *Rhizobium leguminosarum* had been dealt with.

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* To prevent any unconscious bias during the research, regarding the numbers of *Rhizobia* in these soils, I opened the envelope containing the description and fertility-numbers after the averages had been made.

Two plates were taken, at times which chanced to be convenient, and from these, certain colonies were taken. The only recommendations for the selection were, that the colonies should be *Rhizobia*, and that they should be free from moulds. Freedom from moulds was not a general character of the colonies by the time that they were finally identified as *Rhizobia*, for the moulds run over the surface of the plate, and contaminate the bacterial colonies during the time that the giant colonies are being grown for identification. However, ten colonies were taken from a plate of Expt. viii., containing thirteen colonies of *Rhizobia*, and five colonies from a plate of garden-soil in Expt. ix., which had ten colonies.

The races were grown on saccharine media for several weeks, and finally were smeared over plates of dextrose-agar.*

THE FIXATION OF NITROGEN BY RHIZOBIA.

		Milligrams of Nitrogen fixed: calculated to 100 c.c. of medium.
Soil No. 1	Colony 1	4·5
,,	,, 2	5·2
,,	,, 3	3·0
,,	,, 4	4·1
,,	,, 6	3·7
,,	,, 7	4·5
,,	,, 8	3·7
,,	,, 9	3·4
,,	,, 10	3·7
,,	,, 12	5·6
Garden soil.	,, 2	3·5
,,	,, 3	4·5
,,	,, 4	5·2
,,	,, 5	4·1
,,	,, 8	5·2

With regard to the number of bacteria in soil, there will naturally be great variations; and although we may obtain certain results from their enumeration, it must be remembered that all artificial media are more or less selective. The numbers obtained per grm. of soil will, therefore, generally be low. Lipman says that rich loam soils may contain the enormous total of from 15 to 20 millions per grm. Conn found that the bacteria ranged up to 22 millions in summer, and 33 millions in winter. If we assume, however, that there were 25 millions in the Hawkesbury soil No.1, we realise that the nitrogen-gathering *Rhizobium* is present to the extent of 10% of the total bacteria.

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* For technique, see these Proceedings, 1906, p.608.

In order to get some definite information, however, two soils were obtained from the Hawkesbury Agricultural College in May; one was designated "good," the other "medium." The total bacteria were determined by sowing dilute suspensions upon ordinary nutrient agar, and the *Rhizobia* upon levulose-citrate-agar. The "good" soil contained 4,160,000 bacteria, and 145,600 *Rhizobia* per grm. of dry soil; that is, the *Rhizobia* were present to the extent of 3·5% of the so-called total bacteria. In the "medium" soil, there were 4,858,000 total bacteria, and 20,200 *Rhizobia* per grm., or 0·4%.

In a garden-soil, Mr. C. W. H. Powell, a student in this laboratory, found 12,000,000 bacteria per grm., and 830,000 *Rhizobia*, or 6·75%.

Summary.

1. The number of nitrogen-fixing *Rhizobia* in agricultural soils varied up to three or four millions per gram.
2. The numbers present afford an indication of the comparative fertility of the soil.

ORDINARY MONTHLY MEETING.

SEPTEMBER 27th, 1911.

Mr. W. W. Froggatt, F.L.S., President, in the Chair.

Mr. C. COLES, Roseville, and Archdeacon F. E. HAVILAND, Cobar, were elected Ordinary Members of the Society.

The Donations and Exchanges received since the previous Monthly Meeting (30th August, 1911), amounting to 9 Vols., 56 Parts or Nos., 11 Bulletins, 3 Reports, and 4 Pamphlets, received from 41 Societies, &c., and 2 Individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. D. G. Stead sent, for exhibition, an undetermined ovigerous Pycnogonid, obtained off Nobbys, Newcastle, on the first of the month.

Mr. Steel exhibited specimens of the fresh-water ship-worm, *Calobates fluviatilis* Hedley, (These Proceedings, 1898, p. 91), and a piece of a red-gum pile riddled with their burrows, from fresh water, Ba River, Fiji. This organism has now been found in fresh water in three different rivers in Fiji, the Rewa, Navua, and Ba.

Mr. Baker exhibited (1) a specimen of *Fomes lucidus* Fr., a fungus found growing on Forest Oak props (*Casuarina* sp.) in the coal-mine at Catherine Hill, Belmont, near Newcastle, N.S.W. It grows in clusters and at the tops of the props; the example shown measured 2ft. 10½ inches in length, the longest previously recorded being 10 inches. It was discovered by Mr. W. G. Hall; and this is the first notice of its occurrence in New South Wales on this particular host and in this situation. (2) Also a specimen of the bark of *Melaleuca bracteata* F.v.M., which is quite unique amongst its congeners, in respect of the characters of the bark.

Mr. Cheel exhibited specimens of the English Primrose (*Primula vulgaris*) with well developed foliaceous calyx-segments (phyllodic sepals). The leafy segments cohere rather more than in the figure given by Masters in his "Vegetable Teratology" (p.248, fig.131).

Mr. E. I. Bickford invited the attention of the Society to a matter of public, as well as scientific, interest. In 1892, when resident in West Australia, he had taken an active part in a movement to have a certain area set apart for the protection and preservation of the native flora and fauna.* Accordingly, in 1892, the Premier, Sir John Forrest, authorised the gazetting of an area of 25 square miles between Pinjarra and the Bannister for the purpose named. Since leaving West Australia, the speaker regretted to say that he had learnt that, with a subsequent change of Government, the reservation had been abolished, and most of the land given over to a firm as a timber-concession. This, he thought, was a retrograde step, and very much to be deplored. Emissaries of science from Germany, Great Britain, and even Sweden, had been visiting West Australia of late years, for the purpose of studying and collecting the fauna and flora; and this fact alone should stimulate West Australians to greater activity in taking steps, before it was too late, to secure more adequate protection for the choice characteristic forms. For example, the Christmas-Tree, *Nuytsia floribunda* R.Br., [N.O. *Loranthaceæ*] one of the botanical wonders of Australia, was in grave danger of extermination. One lesson was quite evident—if reservations for the protection of the native plants and animals were to be effective and of lasting value, Trusts must be created, empowered by Act of Parliament to take complete control of them, as in the case of the National Parks of the other States, in order to safeguard them from the whims of the politician or the wiles of the exploiter.

*** Further particulars of this movement will be found in Mr. B. H. Woodward's paper on "National Parks, and the Fauna and Flora Reserves in Australasia," in Journ. West Aust. Nat. Hist. Soc. No. iv., Nov. 1907, p.13.**

Mr. Fred Turner exhibited and offered observations on *Panicum didactylum* Kunth, (Syns. *Panicum bicorne* Sieb., *Digitaria distachyum* Bojer, and *D. didactyla* Willd.), the exotic "Blue Couch," which is said to have caused the deaths of a number of pasture animals near Muswellbrook, Upper Hunter, N.S.W., in 1907, as reported in the newspapers. The inflorescence of this grass is sometimes infested with a fungoid growth, and the "mysterious" deaths of stock might perhaps be more reasonably attributed to such a source. The exotic Blue Couch is different from the native grass bearing the same vernacular name (*Paspalum brevifolium* Flügge); and may have been accidentally introduced into Australia from Mauritius, in the early trading days. It has long been established in Queensland.

Mr. Froggatt exhibited a small collection of named Australian biting flies (Fam. *Tabanidæ*) comprising *Tabanus concolor* Walk., *T. nigropictus* Meig., *T. ardens* Meig., *T. regis-georgii* Macq., *T. abstersus* Walk., *T. edentulus* Macq., *T. brevidentatus* Macq., *T. jacksonii*, Macq., and *T. gregarius* Erichs., and he pointed out the necessity for a satisfactory knowledge of this group of the Diptera, especially in its bearing on the investigation of tropical diseases.

NOTES ON THE INDIGENOUS PLANTS IN THE COBAR DISTRICT.

By Archdeacon F. E. Haviland.

The following notes deal with plants collected as indigenous in the Cobar district, specimens of most of which are in my collection at Cobar.

The district (for my purpose) may be regarded as comprising an area of 6,000 square miles, and is contained within a radius of 50 miles from Cobar as centre. The physical features of this district comprise red ironstone, red sandstone, quartzite, and soft red soil, with many entire patches wind-swept, leaving the arid subsoil with here and there outcrops of rock. The general aspect of the country is flat, but occasionally hills of more or less prominence rise somewhat suddenly.

These divergent geological conditions, to a certain extent, account for the very local habitats of certain species. Hence we get to hear of some parts being called "Yarren Flats," "Salt-bush Country," "Mulga Country." Yet there are problems in the matter of distribution to be solved; for while, for instance, *Prostanthera Leichhardtii*, a newly recorded species for New South Wales, has been noted as occurring only on The Peak, a quartzite elevation riddled by fossickers; it is not found on hills of similar formation only a few miles distant. Then, again, I find many of the smaller plants, whose natural habitat would be on the flats, growing very well on the highest ridges, and can only account for their presence by the very heavy dust-storms, so characteristic of these parts, carrying up the seed, which thus becomes automatically planted on the ridges, and in its own soil also thus carried there.

Such apparent anomalies as these may seem to intensify the difficulty of establishing certain fixed theories of plant-distribution; yet, I believe there is a reason for everything, and further explorations may not only clear up these anomalies, but even confirm the most exacting hopes of the tabulating theorist.

I must confess to having found a very real difficulty in arriving at the correct determination of some of the larger species, and this has been caused through the many variations offered by species of the same genera. I find this particularly in the genera *Callitris* of the Conifers, *Hakea* of the Proteads, *Casuarina* of the Casuarineæ, and *Dodonæa* of the Sapindaceæ. I need mention but two cases noted herein, *Hakea vittata*, which has the general characteristics of the species, but the fruits of *H. Pampliniana*; while again, on the same tree of *Casuarina lepidophloia*, I have found fruits not only of that species, but also large ones approaching those of *C. Cambagei*. It is this kind of occurrence that has caused me to hesitate before calling another specimen *H. leucoptera*.

The general appearance of the vegetation of this district is that of brush-wood, very few trees rising to any eminence, such as is attained by examples of *Eucalyptus intertexta*, *E. populifolia*, and two unusually fine specimens of *Casuarina lepidophloia* at Lerida, fully 80 feet high, and of which Mr. Oakden—whose care for his trees is scarcely less than that for his sheep—is very justly proud. The main building-timber of these parts is *Callitris glauca*, Cypress Pine; but as there are no trees of any suitable dimensions for the larger purposes, most of that requisite has to be imported from "down country," though a limited supply of "Black Pine," *Callitris calcarata*, is obtained from Nymagee.

The temperature of this district varies between somewhat extreme limits, but, normally, may be said to range from 60° to 110° F., and the hills and ridges, being of no important altitude, do not make any appreciable difference as to temperature. The altitude of Cobar itself is 805 feet above sea-level, and its distance from the coast, easterly, in a straight line is 420 miles.

A noteworthy feature of this country, from a botanical point of view, is the very poor representation of Monocotyledonous plants, lilies and orchids being specially rare; and as for the grasses, the range of species, as compared with the genera, is not wide. I am informed, on good authority, that the mainstay of the stock is in the Stipas (Spear or Corkscrew-Grasses), next in the Danthonias, and lastly in the Anthistirias (Kangaroo-Grasses). The Stipas, however, are very troublesome to the sheep, on account of the long awns. The Acotyledonous plants, also, have a poor representation; the ferns, for instance, being represented by only four species. It may be accounted for by the fact that the meteorological nature of these parts is decidedly droughty, the rainfall being only 14 inches per year, the temperature high, and the atmosphere dry; indeed, it is with great difficulty that, in private gardens, any of these plants can be reared.

Included in the following list are certain naturalised plants which having been so long established, are regarded as "at home" here; but these I have marked with an asterisk(*).

As a help to local identification, I have inserted the vernacular names against such plants as are so known here; but they can form only a rough guide, as vernacular names differ very often even in the same district. The "Pin-Bush" of Cobar itself is *Acacia colletioides*, but in the more distant parts of the district it is the *Hakea vittata*; while again the "Kurrajong" of these parts is the *Sterculia diversifolia*, but of the northern rivers it is the *Commersonia echinata*, or, indeed, any tree from which the Natives used to strip shreads for binding purposes.

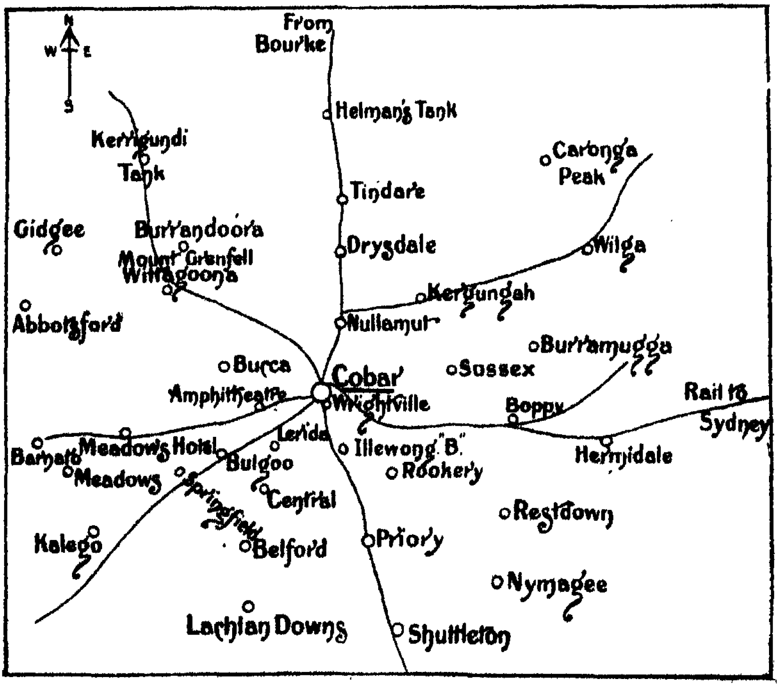
The mention of the months after each species, is intended to indicate the time when that species is in full bloom.

There is one want in the "far west," the existence of a Public Museum or Herbarium, located at such a centre as this. There can be no more pleasurable pursuit for the residents than to have characteristic specimens of the natural history of their district brought within easy reach and observation. In such a locality as this, there is material for a useful Institution for the preservation of specimens in most departments of Natural History. Indeed, such could be maintained at little expense to the State, there being always several scientific men connected with the development ef the local mines, who, for the recreation to be got out of it, would undertake to collect, and to classify specimens; while the whole affair could be placed under the care of honorary trustees. This is the only way I can see of educating the residents to a knowledge of the wealth of their natural surroundings.

In writing the notes on the various species, I have consulted, and, in a few cases, borrowed from leading authorities.

Further, I wish to acknowledge, with many thanks, the assistance I have received from several parties interested in the Australian Flora. I may mention Mr. E. C. Andrews, whose wide geological knowledge brought him to be interested in botanic research; also Mr. L. Abrahams, a most assiduous collector of specimens. Both these gentlemen brought in to me, for determination, some of the plants herein named. I am also indebted to Mr. J. H. Maiden, our worthy and esteemed Government Botanist, and his staff, for their courteous confirmation or correction of any diagnosing of which I myself might have had any doubt.

For the purpose of assisting in localising the various places mentioned, I append a map of the Cobar district.



It is my intention to issue a supplementary list later on, as there are many specimens I have not succeeded in getting sufficiently complete to determine their places in the list.

Synopsis of Plants noted.

DYCOTELYDONS.

Orders.	Genera.	Species.	Orders.	Genera.	Species.
Ranunculaceæ ...	1	1	Goodeniaceæ ...	3	8
Papaveraceæ ...	1	1	Campanulaceæ ...	2	2
Cruciferæ... ...	7	13	Primulaceæ ...	1	1
Capparideæ ..	2	2	Jasmineæ ...	1	2
Resedaceæ ...	1	1	Apocyneæ ...	2	3
Pittosporeæ ...	1	1	Asclepiadeæ ...	3	3
Caryophylleæ ...	2	2	Gentianeæ ...	1	1
Portulaceæ ...	2	2	Boragineæ ...	4	4
Malvaceæ	7	10	Convolvulaceæ	3	3
Sterculiaceæ ...	1	1	Solaneæ ...	3	8
Lineæ	1	1	Scorphularineæ	3	3
Zygophylleæ ...	2	5	Bignoniaceæ ...	1	1
Geraniaceæ ...	2	2	Acanthaceæ ...	1	1
Rutaceæ	3	4	Myoporineæ ...	2	10
Meliaceæ	1	1	Verbenaceæ ...	2	2
Celastrineæ ...	1	1	Labiatæ ...	3	6
Stackhousieæ ...	1	1	Plantagineæ ...	1	1
Rhamneæ	1	1	Salsolaceæ ...	8	22
Sapindaceæ ...	3	7	Amarantaceæ ...	3	8
Leguminosæ ...	12	36	Polygonaceæ ...	3	4
Crassulaceæ ...	1	1	Nyctagineæ ...	1	1
Halorageæ ...	1	1	Proteaceæ ...	2	4
Myrtaceæ	1	6	Thymeleæ ...	1	2
Onagrarieæ ...	1	1	Euphorbiaceæ ...	3	3
Cucurbitaceæ ...	1	2	Urticeæ ...	2	3
Umbelliferæ ...	2	2	Casuarineæ ...	1	3
Loranthaceæ ...	1	7	Santalaceæ ...	3	3
Rubiaceæ	4	4	Coniferæ ...	1	3
Compositæ	33	53			

MONOCOTYLEDONS.

Orchideæ	1	1	Cyperaceæ ...	3	3
Liliaceæ	3	3	Gramineæ ...	21	36
Juncaceæ	2	4			

ACOTYLEDONS.

Order.	Genera.	Species.	Order.	Genera.	Species.
MARSILIACEÆ ...	1	2	FILICES ...	4	4

	Orders.	Genera.	Species.
Dicotyledons... ...	57 ...	162 ...	284
Monocotyledons ...	5 ...	30 ...	47
Acotyledons	2 ...	5 ...	6
	64	197	337

INDIGENOUS PLANTS IN THE COBAR DISTRICT.

Class I. DICOTYLEDONS.

Subclass POLYPETALÆ.

Series i. Thalamifloræ.

RANUNCULACEÆ.

RANUNCULUS PARVIFLORUS Linn. In damp situations, five miles from Cobar, on the Wilcannia Road, and at The Peak. August.

PAPAVERACEÆ.

*ARGEMONE MEXICANA Linn. "Mexican Poppy." Cobar generally; February-March. On waste places. A troublesome weed, having prickly leaves and very narcotic seeds. Known also as the "Infernal Fig" of the Spaniards. I have used a decoction of the juice as a stain imitating a light oak.

CRUCIFERÆ.

BARBAREA VULGARIS R.Br. A yellow-flowered weed about homesteads in many parts. May.

BLENNODIA TRISECTA Benth. General in the district. Flowers most of the year. White.

B. LASIOCARPA F.v.M. General. March.

STENOPETALUM LINEARE R.Br. At Nullimut Tank. August.

CAPSELLA ELLIPTICA Meyr. Cobar. August.

C. HUMISTRATA F.v.M. Cobar generally. May. Yellow.

*CAPSELLA BURSA-PASTORIS Mœnch. "Shepherd's Purse." Cobar generally. April.

LEPIDIUM LEPTOPETALUM F.v.M. Getting very common about Cobar, especially on sandy flats. It is not relished by stock, hence it is overrunning good ground. April.

L. MONOPLOCOIDES F.v.M. August. Everywhere.

L. PAPILLOSUM F.v.M. Cobar generally. July.

L. RUDERALE Linn. "Mustard-Plant." On waste lands, generally. Taints milk. February-March.

SISYMBRIUM OFFICINALE Scop. About Nymagee. Supposed to be good for chest-troubles. September.

SENEBIERA DIDYMA Pers. "Wart-cress." Near Cobar. August.

CAPPARIDEÆ.

CAPPARIS MITCHELLI Linn. "Wild Orange." General, but not so frequent in the eastern part of the district. Summer. The fruit, which is as large as an ordinary orange, is extremely pungent. Rabbits are very partial to the bark and wood. I have seen 10-foot shrubs of this species gnawed right through the stems by rabbits. Timber white and soft.

APOPHYLLUM ANOMALUM F.v.M. Rightly so-called from its strange, leafless appearance. "Warrior Bush." The female bush is smaller and weaker. The young shoots only are nibbled by stock. I am trying this wood as a substitute for Holly. October-November.

RESEDACEÆ.

*RESEDA LUTEOLA Linn. "Dyers' Weed." A species of the Mignonette-family has established itself in many parts of the district.

PITTOSPOREÆ.

PITTOSPORUM PHILLYRÆOIDES DC. "Berrigan." Cobar and Lerida. Prefers stony ground, and is found in company with the Heterodendrons. October.

Caryophylleæ.

*Sagina procumbens Linn. On the flats about the district. July.

Spergularia rubra Cambess. "Sandy Spurrey." On damp situations about Cobar. July.

*Spergula arvensis Linn. About Cobar. August.

Portulaceæ.

Portulaca oleracea Linn. "Pig-Weed." "Purslane." Cobar, July.

Calandrinia calyptrata Hk. Everywhere, common. August.

Malvaceæ.

*Lavatera plebeia Sims. Common. "Tall Marsh-Mallow." Meryula. November.

Malvastrum spicatum Gray. Cobar, and at the northern parts of the district. February.

Sida corrugata Linn. The commonest form about here, and spreading all over the district. Summer.

S. subspicata F.v.M. District generally. September-February.

S. virgata Hk. A twiggy shrub; seems to prefer elevated rocky ground. February

Some of the species called "Paddy's Lucerne."

Abutilon Fraseri Hk. Not particular as to soil or situation. A good plant for pots. February.

A. otocarpum F.v.M. Between Bourke and Cobar. (In Mr. R. H. Cambage's Collection).

Hibiscus Sturtii Hk. On red stony hills about Cobar. An attractive plant for pot-growing, having showy purple flowers. February.

Gossypium Sturtii F.v.M. "Desert-Rose." A native of the more westerly and desert parts, but now being worthily brought into private gardens. The seeds germinate freely. May. Flowers large, blue and purple.

*Malva rotundifolia Linn. "The common Marsh-Mallow." Cobar generally. February-March.

STERCULIACEÆ.

STERCULIA DIVERSIFOLIA G. Don. "Kurrajong." Cobar generally. December-January. One of the best of our ornamental shrubs, and a valuable fodder. It is becoming scarce through being used for stock, as well as the young plants being rooted up for transplanting, to which, on account of its long tap-root, it does not take kindly. It grows anywhere. Its bark contains a gum.

Series ii. **Discifloræ.**

LINEÆ.

LINUM MARGINALE Cunn. "Australian Flax." The Peak. September.

ZYGOPHYLLEÆ.

TRIBULUS TERRESTRIS Linn. "Bulldogs." Cobar; especially partial to damp soils. A troublesome weed, especially to cyclists.

ZYGOPHYLLUM APICULATUM F.v.M. A succulent herb about the district, and having pointed fruits which are troublesome to cyclists. July.

Z. FRUTICULOSUM DC. Cobar, on soft ground. July.

Z. IDIOCARPUM F.v.M. Cobar generally. July.

Z. AMMOPHILUM F.v.M. A few plants only noticed at Cobar. July.

GERANIACEÆ.

ERODIUM CYGNORUM. "Crow-foot." Grows anywhere, and is a splendid fodder-plant. It is considered by some as a stimulant I have seen plants of this, on the Darling, overtop the fences of the sheep-paddocks. August.

OXALIS CORNICULATA Linn. Everywhere in shady spots, especially under low bushes. It contains oxalic acid, and is sometimes used for removing ink-stains. Makes a showy border-plant. February.

RUTACEÆ.

GEIJERA PARVIFLORA Lindl. "Wilga," Everywhere common. Flowers almost throughout the year. Having heavy pendulous foliage, it is the best shade- and shelter-tree of the west, and hence is greatly sought after by travellers. Stock, in these parts, will not eat the foliage. The trees do best on flat country. I have made good ink, free from grit, by boiling down the bark.

ERIOSTEMON DIFFORMIS A. Cunn., var. TERETIFOLIA. On broken, stony ridges at Elouera and Mount Boppy. It grows in company with *Eucalyptus Morrisii* and *E. viridis*. October-March.

E. SCABER Paxt. On the rocky plateau of Mount Grenfell. Grows in gregarious patches. August.

PHEBALIUM GLANDULOSUM Hk. A beautiful shrub, which would adorn any Sydney garden. At Cobar, it grows on ridges, but is not particular to that situation. July.

MELIACEÆ.

FLINDERSIA MAQULOSA F.v.M. "Leopard-Wood Tree." A beautiful, ornamental tree, with spotted bark, and festoons of creamy flowers. Its fruits are collected by the residents in its neighbourhood, and made into numerous ornaments—frames, pin-cushions, etc. Rabbits are very fond of the bark, and, in dry seasons, I have seen dead rabbits round about the vicinity of these trees; the bark being indigestible, quickly kills them. On Devonian ridges, principally about Amphitheatre, but I have seen it on gravelly flats at Bourke. Flowers in November.

CELASTRINEÆ.

CELASTRUS CUNNINGHAMII F.v.M. Forty miles north of Cobar. (In Mr. R. H. Cambage's Collection).

STACKHOUSIEÆ.

STACKHOUSIA VIMINEA Sm. In shaded spots about Elouera. February.

RHAMNEÆ.

VENTILAGO VIMINALIS Hk. Known as "Supple Jack." I have not seen this shrub flower here. It is scarce. I have only one specimen, from Wittagoona, but Mr. Cambage found it, some years ago, near Cobar.

SAPINDACEÆ.

DODONÆA VISCOSA Linn. The "Hop-Bushes." The pods were sometimes used by early settlers as hops. This species has a resinous scent, and it is said to have been used for fomentations. The Dodonæas do best on soft, red soil, in slightly elevated situations. They are very attractive, with their differently colored, winged capsules. It is a diœcious plant, as are its sister species, and the staminate plants are rare. There are several varieties, such as *D. cuneata* and *D. vulgaris*, growing about Cobar, and they are at their best about summer.

D. LOBULATA F.v.M. Leaves with small teeth on each side. Cobar generally. Summer.

D. SPATHULATA. A rare species, growing at the Clay Pits, and on Nyngan Road, near Cobar. June.

D. PETIOLARIS F.v.M. On rocky ground at Wittagoona. This species, from the size of its capsules, resembles the "Money-Plant." It fruits in October.

ATALAYA HEMIGLAUCA F.v.M. "White Wood," or "Bulcan." At Wittagoona. Fruits in January.

HETERODENDRON OLEÆFOLIUM Desf. Growing about Lerida. It is a good fodder-bush. In company generally with Santalums. November.

H. DIVERSIFOLIUM F.v.M. "Broad-leaved Apple-Rosewood." About Lerida, in company with the last-mentioned species. It is known as a "Blue Bush." November. Good fodder-bush.

Series iii. **Calyciflorae.**

Leguminosæ.

Suborder i. *Papilionaceæ.*

Bossiæa Walkeri F.v.M. "Stick-Bush," "Warrigal." On soft, damp ground, growing in patches about Cobar, and in company with Eremophilas. September. The leafless, flat branches give this shrub a very peculiar appearance. Its flowers are very attractive in red and yellow, and, by horticultural art, the plant is capable of profuse flowering, and is worth bringing into private gardens.

Templetonia egena Benth. Cobar generally. September.

Lotus australis Andr., var. parviflorus. At Wittagoona and Kergunyah. September.

Indigofera australis Willd. A graceful-looking shrub; on rocky hills, in company with *E. Morrisii* and *Callitris glauca.*

Clianthus Dampieri Cunn. "Desert-Pea." About Mount Grenfell Head Station. August.

Swainsona Burkittii F.v.M. The Darling-Pea tribe. In the extreme west of the district. October.

S. lessertiifolia DC. Everywhere in district. August.

S. microphylla Grey. In company with the previous species, but much smaller. September. Both these species appear to me to have much the same nature as the "Poison-Pea," and the stock seem to avoid them. I have not found the true Poison-Pea, so far, in this district, though it grows plentifully on the Darling and at Bourke.

S. phacifolia F.v.M. About Cobar. August.

Glycine sericea Benth. Cobar generally. February and September.

*Medicago denticulata Willd. Several places about Cobar. Fruiting in June.

*M. minima. Cobar and Brura Tank. August.

Suborder ii. *Cæsalpinieæ.*

Cassia laevigata Willd. Though a coastal plant, it has gained introduction here, probably through private gardens.

C. **Sophera**, var. **schinifolia**. Not common about Cobar, but regarded in the eastern parts as a nuisance. March.

C. **desolata** F.v.M. A desert-species. My specimen is a glabrous form, from Amphitheatre. September.

C. **artemisioides** A. Cunn. "Punta," or "Cooma-Bush." The presence of this, and of the following species, is held by some residents to be responsible for the occurrence of hay-fever. The Cassias are the Senna-plants of the east, and contain purgative principles. The stock do not care for the foliage, hence it spreads and kills out other shrubs. The plants are, however, showy, and flower in the spring.

C. **eremophila** A. Cunn. Cobar generally; but, unlike the preceding species, this grows to a height of 10 feet on watered soil. It seems to have a tendency to run into the previous species through its foliage, sometimes having three or four pinnæ. It flowers about August.

Var. **platypoda**, near Cobar Cemetery.

Var. **zygophylla**, near Cobar East.

C. **circinata** Benth. Growing at Amphitheatre, and 12 miles north of Cobar. December.

C. **Sturtii** R.Br. Cobar and Amphitheatre. August.

Petalostyles labicheoides R.Br. A very showy plant, growing on stony elevations at Cobar, Illewong, Kergunyah, and Amphitheatre. September.

Suborder iii. *Mimoseæ.*

Acacia Willd. The Wattle-tribe. Some Acacias are noted for the gums they exude, but I have seen very little from the local species. Most of the following species do not appear gregarious in their habits, but are intermixed with each other on various soils and situations; exceptions to this are *A. homalophylla* and *A. cyperophylla*. Not many seem to be relished by stock.

A. **ANEURA** F.v.M. There are several varieties known as "Mulga" general in the district. This is considered as the best, and most plentiful fodder-bush in the West. The long-leaved variety the stock will eat greedily, but they sometimes eat down to the small sticks, which form a leathery ball in the stomach, causing death if not removed by an operation. I have seen one such ball about the size of a goose-egg. There is a shorter, narrow-leaved variety which is also relished; and a broad-leaved variety which is not liked at all, the leaves being very tough, and probably containing a bitter principle. From the habit of growth of this latter variety, and from the fact that sheep avoid it, I am inclined to think it should be regarded as a different species. The Mulgas flower in the spring and summer.

A. **CIBARIA** F.v.M. The pods are cylindrical and an inch and a quarter long, dehiscing from the base, and containing only from one to three seeds, placed longitudinally. It is known as "Umbrella-Mulga," and approaches the long, narrow-leaved variety. July and August.

A. **HOMALOPHYLLA** A.Cunn. "Yarren." This Acacia grows in acre-clumps on soft flats, and in company with *Eucalyptus populifolia* and *Eremophila Mitchelli*. The phyllodia are too thick and coriaceous for the stock to eat. September.

A. **SALICINA** Lindl. The hanging branches resemble the willow, hence its name. It is scarce in the district. December.

A. **HAKEOIDES** A. Cunn. "Black Wattle." General in the district. September.

A. **JUNCIFOLIA** Benth. On the Nyngan Road, six miles from Cobar. August.

A. **COLLETIOIDES** A. Cunn. "False Pin-Bush." Everywhere in the district, though not plentiful towards the eastern parts. It does best on stony slopes, and its pungent-pointed foliage prevents it from being browsed. It is the first of the local Acacias to flower. June.

A. DECORA Reichb. "Silver Wattle" of Cobar. This handsome bush is not plentiful here, but grows in small clumps on the sides of stony ridges, and produces a mass of flowers in September.

A. MURRAYANA F.v.M. Wittagoona, Springfield. September.

A. TETRAGONOPHYLLA F.v.M. "Dead Finish." On sandy Devonian ridges generally over the western portion of the district. September.

A. OSWALDI F.v.M. "Dead Finish," "Milgee." In many forms about Cobar. June.

A. DORATOXYLON A. Cunn. "Currawong," or "Spearwood." Prefers stony ridges, though a few bushes grow on the flats. One of the most beautiful Acacias, having fully inch-spikes of flowers, and very profuse. It associates with *Eucalyptus Morrisii* and *E. viridis*. A broad-leaved variety is found on Devonian quartzite-ridges. Wittagoona. August.

A. CYPEROPHYLLA F.v.M. "Needle-Bush." Grows in gregarious clumps about Elouera, Cobar, and Kergunyah; it prefers flat, damp soil. It has spikes of flowers fully half-inch long, and is often found with "Yarren" and "Mulga." October.

A. DECURRENS Willd., var. MOLLIS. This is not plentiful; my specimen came from Wittagoona, but I have also collected it at Kergunyah, where there are only two bushes of it. But it is very delicate, and cannot stand rough weather. October.

A. EXCELSA Benth. There is only a small-leaved variety about Cobar, hardly a worthy representative of its Queensland type. It has a peculiar habit of preferring isolation from other trees, and grows on flat, desolate parts. It is called here "Ironwood," and does not seem to flower every year. February.

*ALBIZZIA LOPHANTHA F.v.M. At Nullimut. August.

CRASSULACEÆ.

TILLÆA sp.(?). Cobar.

HALORAGEÆ.

MYRIOPHYLLUM sp.(?). At Nullimut Tank. August.

MYRTACEÆ.

EUCALYPTUS L'Hér. The Eucalypts are exceedingly poor in the district, there being only about half-a-dozen representatives. The Mallee-type prevails.

E. **DUMOSA** A. Cunn. "Mallee." Cobar generally. September.

E. **OLEOSA** F.v.M. "Mallee." Cobar generally. August.

E. **INTERTEXTA** R. T Baker Grows here to a goodly-sized tree, with a white trunk, generally hollow. It takes to the flats, and grows in company with *E. populifolia* and "Yarren." August,

E. **MORRISII** R. T. Baker. On broken elevations at The Peak, Illewong, and Mount Boppy. Its companions are *Eriostemon difformis*, *Cassinia lævis*, and *E. viridis* September.

E. **POPULIFOLIA** Hk. Very plentiful about the district, and principally on the flats in damp situations. It is known as "Poplar-leaf Box," and "Bimbel Box." October. Its wood is considered good for stays, and also for wheelwright work.

E. **VIRIDIS** R. T. Baker, E. **ACACIOIDES** A. Cunn On rocky slopes chiefly, accompanying *A. decora* and *A. aneura*, both at Illewong, Wrightville, and several other spots

ONAGRARIEÆ.

***ŒNOTHERA BIENNIS**, Linn. "Evening Primrose." Near Cobar.

CUCURBITACEÆ.

CUCUMIS TRIGONIS Roxb Everywhere on the soft flats, especially on the traffic-lines. Stock eat this and the following species greedily. March.

*C. **MYRIOCARPUS** Naud. "Paddymelon." On soft soil generally in the district, and on the tracks. The small, prickly fruit is considered dangerous to cattle, causing flatulency.

UMBELLIFERÆ.

ERYNGIUM PLANTAGINEUM F.v.M. "Cockspur." Wittagoona. October.

DAUCUS BRACHIATUS Sieb. About Cobar.

Subclass II. Monopetalæ.

LORANTHACEÆ.

LORANTHUS Linn. The Mistletoe Family.

L. **PENDULUS** Sieb. On almost any shrub in Cobar district generally. The commonest form here. Flowers in November, in many varieties.

L. **LINEARIFOLIUS** Hk. Generally on the Casuarinas about Cobar. Leaves terete. January.

L. **LONGIFLORUS** Desr.(?). My specimen only in fruit. Growing on the Wilgas.

L. **MIRACULOSUS** Miq. A small, pretty flower, on the Wilga trees, as a rule. June.

L. **QUANDANG** Lindl. On Santalum trees and others, generally about Cobar. March.

L. **EXOCARPI** Behr. About Cobar district generally. Yellow Mistletoe. June.

L. **GRANDIBRACTEUS** F.v.M. The large floral leaves are wanting in my specimen. I have only one instance of it, from Amphitheatre. February.

RUBIACEÆ.

CANTHIUM OLEIFOLIUM Hk. "Wild Lemon." On Mulga-country, and also on stony ridges. General in the district. The stems being very straight and the wood somewhat tough, it should be of some use commercially, but it does not exceed, say, five inches in diameter. It is profuse in flowering about November.

OPERCULARIA DIPHYLLA Gært. On gravel country, east of Cobar.

ASPERULA OLIGANTHA F.v.M. Cobar. August.

GALIUM GAUDICHAUDI DC. About the Old Reservoir, Cobar. August.

COMPOSITÆ.

*CENTAUREA MELITENSIS Linn. A "Star-Thistle." "Cockspur." Becoming a nuisance all over the district.

OLEARIA DECURRENS A. Cunn. Good for decorative purposes. Cobar generally. March-May.

O. PIMELIOIDES A. Cunn., var. MINOR Often in company with the previous species, and always follows it in flowering. August.

O. SUBSPICATA Benth. On stony elevated ridges at The Peak. The spikes are short and leafy.

VITTADINIA AUSTRALIS A. Rich. Common everywhere. March.

V. SCABRA DC. March. Common.

*ERIGERON LINIFOLIUS Willd. "Cobblers' Pegs" A common weed. February.

MINURIA LEPTOPHYLLA DC. One of the local daisies. Everywhere. March.

CALOTIS HISPIDULA F.v.M. A burr, as also the following. March.

C. CUNEIFOLIA R.Br. "The Bogan-Flea." February and September.

C. LAPPULACEA Benth. About Cobar.

BRACHYCOME TRACHYCARPA F.v.M. A local daisy. Plentiful on cultivated flats. February.

B. CALOCARPA F.v.M. Near Cobar. August.

B. PACHYPTERA Turcz. Old Reservoir. August.

B. MELANOCARPA F.v.M. Near the Cobar Cemetery. July.

B. HETERODONTA DC. Cobar. August.

*XANTHIUM SPINOSUM Linn. "The Bathurst-Burr." Reputed poison; but its spinescent leaves make it avoided by stock.

SIEGESBECKIA ORIENTALIS Linn. In gullies, at Amphitheatre. August.

COTULA AUSTRALIS Hk. Everywhere common. June.

Soliva anthemifolia R.Br. Cobar Flats. A plant of a pincushion appearance, belonging to the coast but firmly established at Cobar. August.

Myriogyne minuta Less. An aromatic plant. Cobar. February.

Isoetopsis graminifolia Turcz. Damp flats about Cobar. July.

Angianthus pusillus Benth., var. polyanthus. A peculiar, straw-coloured herb, in the western parts. March.

Gnaphalodes uliginosum A. Gray. On flats in several parts. Its silvery rosette-form makes a good saucer-plant. May.

Craspedia chrysantha Benth. Wittagoona. October.

Cassinia lævis R.Br. Cobar district generally; it seems to grow to a height of ten feet on rocky elevations. February, March. Accompanies *E. Morrisii.*

Rutidosis helichrysoides DC. Scarce about Cobar. May.

Millotia tenuifolia Cass. In shaded situations about Cobar.

Ixiolæna leptolepis Benth. Cobar. October.

Helichrysum apiculatum DC. Everywhere. February, September. Also a woolly variety at Kergunyah.

H. semipapposum DC. In several parts. May.

H. bracteatum Willd. Everywhere. September.

Helipterum strictum Benth. At Wittagoona.

H. floribundum DC. A daisy, preferring damp flats, and covering large patches with snow-white flowers. Everywhere. September.

H. moschatum Benth. Wittagoona. October.

H. Jesseni. Common about the district. September.

H. incanum DC. A yellow variety, with broad leaves. August.

H. pygmæum Benth. About Cobar. July, August.

H. dimorpholepis Benth. Common. August.

Leptorhynchos ambiguus Benth., var. semicalvus. Among the rocks at Illewong and at the Peak. Scarce. March.

GNAPHALIUM JAPONICUM Thunb. Cobar. June, September.

G. LUTEO-ALBUM Linn. Common about the district. August, September. "Cudweed."

STUARTINA MUELLERI Sond. The Peak. July.

ERECHTITES QUADRIDENTATA DC. About Cobar and Amphitheatre. August, September.

E. HISPIDULA DC. In gullies about the slopes at Amphitheatre. August.

SENECIO LAUTUS Forst. A showy, yellow-flowered plant. About Cobar generally. July and September.

S. PLATYLEPIS DC. Cobar. September.

S. BRACHYGLOSSUS F.v.M. Near Cobar.

*ONOPORDON ACANTHIUM Linn. "Scotch Thistle." General

MICROSERIS FORSTERI Hk. Cobar. January.

*SONCHUS ARVENSIS Linn. "Sowthistle." Everywhere.

CYMBONOTUS LAWSONIANUS Gaud. Common about Cobar. September.

CRYPTOSTEMMA CALENDULACEA R.Br. Very local, and along a watercourse at Cobar.

*INULA GRAVEOLENS Desf. "Stinkwort." Becoming a nuisance on waste lands and roadsides. May.

GOODENIACEÆ.

GOODENIA CYCLOPTERA R.Br. General. September, March.

G. GRACILIS R.Br. On the western extremes of the district. October.

G. HETEROMERA F.v.M. Common about Cobar. March, September.

G. GENICULATA R.Br. Cobar and Mount Boppy. March.

G. HETEROPHYLLA Sm. Cobar. August. Scarce.

G. PINNATIFIDA Schl. Common about the district. March, September.

SCÆVOLA SPINESCENS R.Br. All about Cobar, intermixed with bushes, which give it support.

BRUNONIA AUSTRALIS Sm. On stony ridges at Mount Boppy, Mount Grenfell, and Wittagoona. A beautiful little plant, very suitable for pot-culture. March, September.

CAMPANULACEÆ.

ISOTOMA AXILLARIS Lindl. On elevations and stony parts about Cobar and Mount Boppy. January, March. A beautiful plant, but poisonous, and having a strong narcotic odour. The flowers are long-tubular, and of lilac colour.

WAHLENBERGIA GRACILIS DC. "Blue Bell." District generally. February, March.

PRIMULACEÆ.

***ANAGALLIS ARVENSIS** Linn. Common about Cobar. "Pimpernel." August.

JASMINEÆ.

JASMINUM LINEARE R.Br. A climber, and general in the district. January, March.

J. SUAVISSIMUM Lindl. A less attractive plant than the preceding. At Mopone.

APOCYNEÆ.

LYONSIA R.Br. "Blackfellows' Candles."

L. EUCALYPTIFOLIA F.v.M. Generally in district. Its very sweet scent is detected at a long distance. It is a heavy climber, with profuse yellow flowers. There is also a narrow long-leaved variety.

L. RETICULATA F.v.M. At Kergunyah. I have never seen this species so far west before, and as yet have found only this single plant, strong, and firmly established, among other bushes.

ALSTONIA CONSTRICTA F.v.M. "Quinine-Bush." At Wittagoona, and Mount Drysdale.

ASCLEPIADEÆ.

SARCOSTEMMA AUSTRALE R.Br. "Gaoloowurra." Amphitheatre. This strange-looking, leafless trailer is not plentiful here. It grows about some hills over old trees and rocks, and is variously reputed to be poisonous to stock. The Blacks used the juice as a liniment for small-pox.

PENTATROPIS (DÆMIA) QUINQUEPARTITA Benth. Four miles north of Cobar. (In Mr. R. H. Cambage's Collection.)

MARSDENIA LEICHHARDTIANA F.v.M. Growing over small bushes about Cobar. Young plants are plentiful, but very few seem to survive.

GENTIANEÆ.

ERYTHRÆA AUSTRALIS R.Br. "Centaury." Cobar generally. It contains a bitter principle, and is used as a tonic. It is frequently made-up like tea, by miners as a specific for rheumatism. November.

BORAGINEÆ.

HALGANIA CYANEA Lindl. Growing on the hills about Cobar. It has a strong claim to a position in flower-gardens as a border-plant. It has small bird's-eye flowers, with yellow centre. October.

CYNOGLOSSUM SUAVEOLENS R.Br. On cultivated patches at Cobar. June, August.

ERITRICHIUM AUSTRALASICUM DC. Common about the district. August.

*__LITHOSPERMUM ARVENSE__ Linn. "Corn-Cromwell." Cobar. October.

CONVOLVULACEÆ.

EVOLVULUS ALSINOIDES Linn. District generally. December.

CONVOLVULUS ERUBESCENS Sims. Common. November. Also a palmate-leafed variety, at Amphitheatre.

SOLANEÆ.

SOLANUM Linn. "Nightshades."

S. ESURIALE Lindl. On flats, especially those flooded with water. The blacks are said to have relished the berries. November.

S. EREMOPHILUM F.v.M. Amphitheatre. December.

S. FEROCISSIMUM Lindl. General. December.

S NIGRUM Lindl. "Black Nightshade." The berries are dangerous when unripe, though children frequently eat them, and occasionally suffer in consequence. February, March.

S. QUADRILOCULATUM F.v.M. Scarce. At Cobar. February.

S. ELLIPTICUM F.v.M. General in district. February.

NICOTIANA SUAVEOLENS Lehm. On hills about Cobar. August.

*DATURA STRAMONIUM Linn. "Mad Apple," "Thorn-Apple." About the washed courses at Cobar. March. Very narcotic.

SCROPHULARINEÆ.

MIMULUS REPENS R.Br. "Monkey-Flower." Near the Chesney Tanks, Wrightville. August.

MORGANIA GLABRA R.Br. Cobar. October.

*VERBASCUM BLATTARIA Linn. At Cobar and Wittagoona. Fruit in January.

BIGNONIACEÆ.

TECOMA AUSTRALIS R.Br. Common on hills. A beautiful climber over trees in elevated situations, and having festoons of cream-coloured flowers of trumpet-shape. October, March.

ACANTHACEÆ.

JUSTICIA PROCUMBENS Linn. At Mount Boppy and Wittagoona. The apparent insignificance of this plant is amply compensated for, by the wonderful provision of "shelves" on each side of the pod, and whereon rest the seeds, attached by delicate funicles.

MYOPORINEÆ.

MYOPORUM DESERTI A. Cunn. "Bridal Bells." The local "Dogwood." District generally, In company with the Dodonæas and Apophyllum. An ornamental shrub, thought to be poisonous, but never eaten by stock. I frequently see children standing round these bushes and eating the berries. It has pretty, pendent flowers in great abundance.

M. PLATYCARPUM R.Br. Cobar, but scarce. November. The flowers are slighty larger than those of the preceding.

EREMOPHILA BOWMANNI F.v.M. At Burramugga, and both blue and white varieties on the Devonian plateau of Mount Grenfell. December.

E. LATIFOLIA F.v.M. "Tea-Bush." A small, viscid bush, principally on sandy slopes about Cobar. June.

E. LONGIFOLIA F.v.M. The commonest form of "Emu-Bush," called so on account of the emus being fond of the seeds. It is also a good edible shrub for stock, and grows everywhere about the district. It is not particular as to soil, though I find it grows to a symmetrical and graceful-looking shrub on damp soils. July.

E. LATROBEI F.v.M. On the Devonian quartzite-ridges at Amphitheatre, and at the Peak. A rather straggling bush, and becoming scarce, but should be encouraged. It is a silvery-coloured shrub, with very attractive flowers.

E. OPPOSITIFOLIA R.Br. From the fact that the leaves are not often found "opposite," but scattered and crowded, it deserves a more appropriate name. To my mind, it is the most attractive of local Eremophilas, having a profuseness of large creamy flowers, and well deserves to be brought in to our gardens. It is found on stony country, and frequently among the Myoporums, Geijera, and "Budtha." July.

E. MACULATA F.v.M. "Native Fuchsia." On the northern extremes of the district, and very scarce. A beautiful shrub, with dark red flowers, spotted. It is reputed to be poisonous when in fruit.

E. MITCHELLI Benth. "Budtha," "Rosewood," "Sandalwood." Everywhere on soft soil as long as not too elevated. The wood is useful for small ornamental work. Flowers profusely in September.

E. STURTII R.Br. "Turpentine-Bush." Very resinous. Cobar generally, and in company with the former species, which it always follows in flowering. October. I think this must be the viscid bush mentioned in Mr. Cambage's list, between Bourke and Cobar, but the flowers were not seen by him. It answers to his description.

VERBENACEÆ.

*VERBENA VENOSA G.&H. At Wittagoona. October. A pest.

SPARTOTHAMNUS JUNCEUS A. Cunn. On soft soil at Cobar. I have seen only one plant in the district. March.

LABIATÆ.

PROSTANTHERA LEICHHARDTII Benth. The Peak. This had been known only as a Queensland plant till found by Mr. E. C. Andrews at the above place. It is to be hoped that its deep purple and green flowers will not attract the ravages of children to eradicate it before getting a good footing. There are only half a dozen bushes of it growing in a "fault" on the Peak. It is very easy to strike, and I have a healthy plant of it in a flower-pot, from a cutting.

P. STRIATIFLORA F.v.M. A very showy shrub at the Peak, Elouera, the "B" Mountain, and Mount Grenfell. It is specially suited for vase-decorations. as the flowers continue at their best for a full fortnight after cutting.

TEUCRIUM RACEMOSUM R.Br. Everywhere. April.

AJUGA AUSTRALIS. "Australian Bugle" Cobar. Flowers during spring.

*MARRUBIUM VULGARE Linn. "Horehound." Used for coughs, and as a tonic. Cobar. February.

DICHONDRA REPENS Forst. Near Old Reservoir. Cobar.

LAMIUM AMPLEXICAULE Linn. Cobar, in paddocks. August.

PLANTAGINEÆ.

PLANTAGO VARIA R.Br. On damp soil, in several places. "Small Rib-grass." February, March. Seems not to grow to the ordinary stature in this climate. Also var. PARVIFLORA.

Subclass iii. MONOCHLAMYDEÆ.

SALSOLACEÆ.

RHAGODIA SPINESCENS R.Br. General. February, March.

R. NUTANS R.Br. Everywhere, especially on hills. February, March.

R. HASTATA R.Br. Cobar and Amphitheatre.

CHENOPODIUM CRISTATUM F.v.M. A common, aromatic weed, chiefly in neglected gardens. March.

*C. MURALE Linn. "Fat Hen." Common. November.

C. ALBUM Linn. General. October.

C. ATRIPLICINUM F.v.M. About Cobar. May.

C. TRIANDRUM DC., var. LANUGINOSUM (*C. microphyllum* F.v.M.). Everywhere. January, March.

ATRIPLEX ANGULATA Benth. Everywhere, on waste places. January.

A. NUMMULARIA Linn. "Old-Man Saltbush." One of the best Saltbushes for fodder. At the western extremes of the district, but grown now as an ornamental shrub in many local gardens. It is fast becoming extinct in its natural habitats, but is easily struck. It does best in black soil. July.

A. STIPITATA Benth. At Lerida. A monœcious form.

ENCHYLÆNA MICROPHYLLA F.v.M. Cobar. July.

E. TOMENTOSA R.Br. Everywhere. Generally a small plant, but, in a few instances, it runs up to a few feet. Intermixed with *Kochia villosa*. April.

KOCHIA VILLOSA Lindl. "Round-leaved Saltbush. District generally. December.

K. BREVIFOLIA R.Br. General. May.

K. APHYLLA R.Br. "Cotton-Bush." In paddocks at Lerida, and a few other spots. May.

K. TRIPTERA Benth. On a quartzite-ridge, four miles west of Cobar July.

SCLEROLÆNA BICORNIS Lindl. "Goat-head." The western extremes of the district. October.

S. PARADOXA R.Br. Western extremes of the district. October.

ANISACANTHA (BASSIA) ECHINOPSILA F.v.M. On elevated, rocky ground at Mount Boppy. March.

A. QUINQUECUSPIS F.v.M. On stony hills about the district. July.

SALSOLA KALI Linn. "Roley-Poley." General in district. The wind breaks off the articulate stems, and, blowing the bushes over the plains, they collect with others, forming big masses. These clog the wire-netted fences, and, in times of heavy rains, are of sufficient weight to drag them down. November-December.

All the salt-bushes here are good feeding, though some are troublesome on account of the spines. The smaller kinds grow well on otherwise bare patches, where grass will not grow. "The Old-Man" is a very wholesome plant for fowls, which are very partial to it.

AMARANTACEÆ.

*AMARANTUS VIRIDIS Linn. *A common garden-weed. General. April.

PTILOTUS INCANUS R.Br. General. November.

P. OBOVATUS Gaud. The commonest form here. April.

P. ALOPECUROIDEUS F v.M. In several places. April.

P. PARVIFLORUS Lindl. On the hills about Cobar. May. Also a glabrous variety from Kergunyah.

P. CORYMBOSUS Gaud. Prefers the flats generally. It has a spreading habit, with ascending branches. May.

ALTERNANTHERA NODIFLORA R.Br. General. March.

A. DENTICULATA R.Br. At Brura Tank. August.

POLYGONACEÆ.

RUMEX BROWNII Campd. "Dock." On rubbish-heaps and waste places generally. March.

POLYGONUM PROSTRATUM R.Br. Old Reservoir, Cobar. July.

*P. AVICULARE Linn. Knot-grass. General. March.

EMEX AUSTRALIS Steinh. Near the Great Cobar Tank. August.

NYCTAGINEÆ.

BOERHAAVIA DIFFUSA Linn. District generally. A good fodder-herb. There are three forms in the district, differing in their foliage. February, March.

PROTEACEÆ.

GREVILLEA STRIATA R.Br. "Beefwood." Amphitheatre and Kergunyah. A handsome tree, preferring stony soil. The foliage is over one foot in length. I have used this wood for ornamental turning, with splendid results, the "veins" showing up well when polished. January-February.

G. ANETHIFOLIA R.Br. Thirty miles north-east of Cobar. (In Mr. Andrews' Collection.)

G. HUEGELII Meiss At Shuttleton

HAKEA LEUCOPTERA (?). I had so written this, but have decided to await flowers. It has fruits longer, and less verrucose than *H. vittata;* and leaves 3 inches long, and straight-pointed, of a glaucous hue.

H. VITTATA R.Br., var. PAMPLINIANA Kipp. About Cobar, Lerida, and Bulgoo. "Pin-Bush." July and September. On almost any soil.

THYMELEÆ.

PIMELEA MICROCEPHELA R.Br. In sheltered situations about Cobar. July.

P. TRICHOSTACHYA Lindl. At Wittagoona.

EUPHORBIACEÆ.

EUPHORBIA DRUMMONDII Boiss. "Caustic Creeper." "Poison-Plant." Growing flat on the ground, in many parts of the district. Very poisonous to sheep.

BEYERIA VISCOSA Miq. Generally understood to be poisonous. Chiefly found on Devonian quartzite-ridges, and in company with some of the Eremophilas. In several parts. October.

BERTYA CUNNINGHAMII Planch. "Boomey," "Broom-Bush." Useful for yard-brooms. Cobar. March.

URTICACEÆ.

URTICA INCISA Poir. "Stinging Nettles." General.

*U. URENS Linn. Common about Cobar. August.

PARIETARIA DEBILIS Forst. Under the shade of bushes at the Cobar Reservoir. August.

CASUARINEÆ.

CASUARINA Linn. "Australian Oaks."

C. LEPIDOPHLOIA F.v.M. "He-oak." Does better on flat, damp soil, though a few trees are growing on ridges. Some splendid trees at Lerida.

C. CAMBAGEI R. T. Baker. "Belah." Several places in the district.

C. STRICTA Ait. (*C. quadrivalvis*). At Mount Boppy. (In Mr. R. H. Cambage's Collection.)

SANTALACEÆ.

FUSANUS ACUMINATUS R.Br. "Quandong." In scrubby parts about the district. There are two varieties, the "Yellow" and the "Red" kinds, the latter being that sought after for jam-making. It retains its "wild" taste, notwithstanding all the art of cooking. Fruits in winter.

SANTALUM LANCEOLATUM R.Br. "Broad-leaved Rosewood." Plentiful in the district, principally in the habitats of the Yarren, and "Mulga." It is regarded as a good fodder-bush. November.

var. ANGUSTIFOLIUM, growing at Lerida. The leaves have plenty of substance, and are of a glaucous hue.

EXOCARPUS APHYLLA R.Br. "Native Cherry." About Cobar, and to the west. Also known as "Native Currant."

Subclass iv. GYMNOSPERMÆ.

CONIFERÆ.

CALLITRIS Vent. "Cypress-Pines."

C. GLAUCA R.Br. Everywhere in the district, but seems to do better on flats than on the ridges, where it gets into straggling habits. The timber is the chief source of building-material here, and is preferred to other woods for the "timbering" of the mines, as it carries the sound of the ground "talking," and hence gives better warning than other timbers, of approaching dangers, to the miners

C. CALCARATA R.Br. About Nymagee. "Black Pine." A stronger and more erect species than the preceding, and preferring hilly country. The timber is superior to that of the previous species.

C. GRACILIS R. T. Baker. This "find" is interesting in view of the fact, that the species has been found before only in the Pilliga scrub. It was described by Mr. Baker in These Proceedings for 1903. This specimen, I found growing to a height of 25 feet, on rather damp, flat soil a few miles from Cobar. It is associated with some Casuarinas, and *Hakea vittata*. September.

Class II MONOCOTYLEDONS.

ORCHIDEÆ.

PTEROSTYLIS RUFA R.Br., var. MITCHELLI. General. September.

LILIACEÆ.

DIANELLA LONGIFOLIA R.Br. Near Cobar. February.

BULBINE SEMIBARBATA Haw. On flats about Cobar. June.

THYSANOTUS BAUERI R.Br. Cobar and Wittagoona. November. Scarce.

JUNCACEÆ.

XEROTES MULTIFLORA R.Br. (?). Among rock at Mount Boppy. March. I have only the pistillate plant.

X. EFFUSA Lindl. On the hills about Cobar. July-August.

JUNCUS PRISMATOCARPUS R.Br. Wittagoona and Mount Boppy. October.

J. COMMUNIS Mey. At Lerida. May.

CYPERACEÆ.

HELEOCHARIS ACUTA R.Br. Wittagoona and the Peak. September.

Cyperus sp. (?). Imperfect. Wittagoona. September.

Carex sp. (?). Imperfect. At Nullimut. August.

GRAMINEÆ.

Eriachne scleranthoides F.v.M., var. elongata. On stony ridges about Mount Boppy.

E. obtusa R. Br. Between Cobar and Bourke. (In Mr. R. H. Cambage's Collection.)

*Lamarckia aurea Moench. Common about Cobar. A pretty ornamental grass. February-March.

Eragrostis Brownii Nees. In parts of the district. May.

E. pilosa Palisot. Cobar generally. October. A very variable, and sometimes very weak, and small grass.

E. laniflora Benth. Between Bourke and Cobar. (In Mr. Cambage's Collection.)

*Poa pratensis Linn. In wet places. An annual, with flat, limp leaves. English Meadow-Grass.

Panicum Linn. Turkeys are very fond of the seeds, hence it is preferred by turkey-farmers.

P. leucophæum Humb. & Bonpl. District generally. The spikelets are very silky. February.

P. divaricatissimum R.Br. In shaded spots, about Cobar. February-March.

P. gracile R.Br. Cobar. A variable but useful grass, not confined to any particular situation. February.

P. sanguinale Linn. Grows into heavy crops on cultivated land, but not very plentiful on scrubby land. "Summer-grass." March.

P. prolutum F.v.M. About Elouera. Is not plentiful. Of a rigid nature, and sometimes called "Rigid Panick."

Neurachne Mitchelliana Nees. "Mulga-Grass." The district generally. A good fodder-grass. February-March.

N. MUNROI F.v.M. Chiefly about the hilly parts, and seeking the shade. A beautiful ornamental grass, but not plentiful. March.

ANDROPOGON SERICEUS R.Br. Cobar and district. "Blue Grass." A useful grass for pastures. December-March.

A. BOMBYCINUS R.Br. Scarce at Kergunyah. April.

ANTHISTIRIA CILIATA Linn. "Kangaroo-grass." One of the mainstays of the grazier. Stock will eat the young shoots, and the flower-heads, but will leave the stems standing as being too coarse. Somewhat general in district. February-March.

ARISTIDA BEHRIANA F.v.M. Everywhere. A full-headed grass. February-March.

A. VAGANS Cav. "No. 9 Grass." General. February.

A. CALYCINA R.Br. Everywhere. February.

STIPA ELEGANTISSIMA Labill. On soft, shaded ground. Cobar. March.

S. SEMIBARBATA R.Br. General in district. This is considered the mainstay among the grasses, although, of late, the awns get troublesome to the sheep both in their wool, and piercing to the mutton. "Cork-screw-Grass." March.

S. SCABRA Lindl. About Cobar. March.

DANTHONIA BIPARTITA F.v.M. On dry parts about Cobar. December.

D. SEMIANNULARIS R.Br. About Bulgoo. May.

PAPPOPHORUM AVENACEUM Lindl. Growing in patches near Cobar. March.

TRIRAPHIS MOLLIS Labill. Western extremes of the district. January. Useful as an ornamental grass; the heads are heavy and nodding.

CYNODON DACTYLON L. C. Rich. "Couch Grass." Growing in patches wherever there is some topsoil. January-March.

CHLORIS ACICULARIS Lindl. "Spider-grass." On damp flats. December-March.

C. TRUNCATA R.Br. "Windmill-grass." "Star-grass." Everywhere on sandy spots. December-March. The Chloris grasses are considered good sheep-grasses.

ELEUSINE ÆGYPTICA Pers. "Button-grass." Cobar generally. March.

DIPLACHNE LOLIIFORMIS F.v.M. Generally in the summer about Cobar, but not lasting long. February.

SPOROBOLUS LINDLEYI Benth. A very tender, but pretty ornamental grass. October.

*BROMUS MOLLIS Linn. Wittagoona. September.

*HORDEUM MURINUM Linn. "Native Barley." Cobar. October.

*AVENA FATUA Linn. "Wild Oats." Wittagoona. October.

Class III. ACOTYLEDONS.

MARSILEACEÆ.

MARSILEA QUADRIFOLIA Linn. "Nardoo." Wittagoona.

M. HIRSUTA R.Br. Common about the district.

FILICES.

OPHIOGLOSSUM VULGATUM Linn. At Nullimut Tank.

CHEILANTHES TENUIFOLIA Sw. In shady places everywhere.

NOTHOLÆNA DISTANS R.Br. Cobar and Mount Boppy. Among rocks.

GRAMMITIS RUTÆFOLIA R.Br. "Blanket-fern." Wittagoona.

NOTES ON THE NATIVE FLORA OF NEW SOUTH WALES.

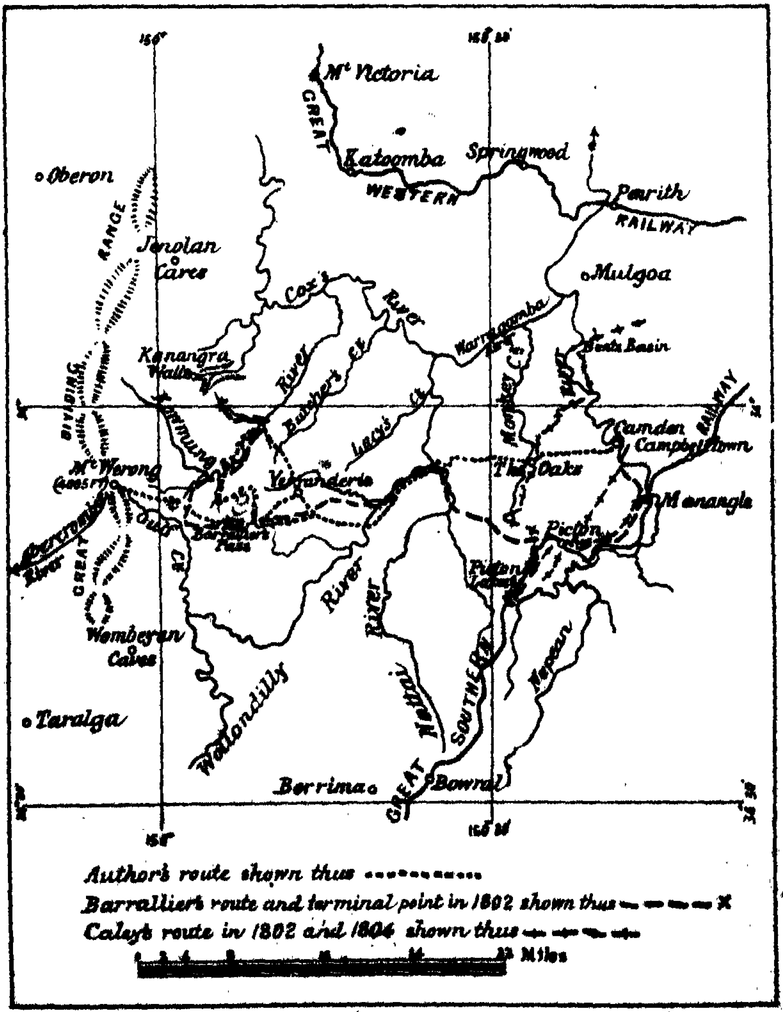
By R. H. Cambage, F.L.S.

Part viii. Camden to Burragorang and Mount Werong.

(*Continued from These Proceedings*, 1909, *p*. 339.)

(Plate xviii.)

The Burragorang Valley and The Peaks, or Yerranderie Silver Mines, are conveniently reached from Camden, the distance to the latter being about 42 miles westerly, while the former is about halfway. Mount Werong is on the summit of the Great Dividing Range, some 70 miles by road westerly from Camden; so that the area discussed in this paper comprises an ascending section, commencing about 20 miles from the coast, at an elevation of 230 feet, and gradually rising along the southern portion of the Blue Mountains, until finally reaching an altitude of 4000 feet above sea-level. Such an area affords some striking examples of the effect of climate upon plant-life. In the eastern portion, coastal forms are noticed, but many of these are gradually left behind as the ascent is made, and cooler regions are reached, their places being taken by types better adapted to withstand the more rigid climatic conditions, and whose homes are on the highest parts of Eastern Australia or in Tasmania. The road followed is full of interest from a geological and physiographic point of view, one of the finest examples of denudation in the State being met with, in the deep valley of the Wollondilly River, which has entrenched itself to a depth of over 1700 feet. As the vegetation is so often regulated by the geological formation, the following outline is furnished of the various formations that are passed, in order that the changes in the flora may be the better understood.



Camden is situated well within the Wianamatta Shale area of the Upper Triassic period, and this formation continues to, and beyond, the little village of The Oaks, which is reached at 9 miles. Within this distance, however, an important change takes place, as although the road at the 4-mile post is only about 80 feet higher than at Camden, or 307 feet above sea-level, during the succeeding 4½ miles, the ascent amounts to 660 feet; and, at a point in this ascent, the Hawkesbury Sandstone makes its appearance, and with it a change in the local flora. The cause of this sudden change of levels has been brought about by the faulting down or folding of the shale-area towards Camden, and the feature is a continuation of the well-known Lapstone monoclinal fold just west of Penrith. After the summit is reached, at about 966 feet above sea-level, the shales are noticed to be much denuded, and gradually thin out in the course of a few miles towards Burragorang. A volcanic dyke, about 3 feet wide, occurs on the left hand side of the road-cutting, about a quarter of a mile short of The Oaks.

From The Oaks to the top of the mountain overlooking the Burragorang Valley, a further distance westerly of 9 or 10 miles, the country rises at a gradual slope from about 950 feet at the village, to approximately 2000 feet on the cliffs overlooking the valley, though the road does not pass over the highest point. The Wianamatta Shales disappear after the first few miles, and the remainder of the road is over Hawkesbury Sandstone.

The following section of levels from Camden to Burragorang, kindly supplied by W. Claude Wilson, L.S., will be found very valuable for reference:—

Levels in feet.		Levels in feet.	
230	Camden	1003	1 m. from The Oaks
307	4 miles from Camden	1683	7 miles from The Oaks
574	5 ,, ,, ,,	1805	Highest Point of Road
636	5½ ,, ,, ,,	1799	8 m.
579	6 ,, ,, ,,	1746	8½ m.
966	8½ (about)	1247	10 m.
944	The Oaks	963	11 m.
870	Werriberri Creek Crossing	246	Bed of Nattai River at crossing

The descent into Burragorang occupies some three or four miles, the point reached being near the junction of the Nattai and Wollondilly Rivers. The road down follows a cutting, which, at one point, winds along the face of the cliff. The valley itself is a magnificent example of stream-denudation. Through the mountain, the waters of the Wollondilly and its tributaries have gradually carved a channel from one to two miles wide, with a depth of 1,750 feet; and, in places, have swept away the whole of the sedimentary strata, which consist of Hawkesbury Sandstone, Narrabeen Beds, and Permo-Carboniferous Sandstones and Shales, including a coal-seam, leaving majestic, towering cliffs on either side, which outline the course of the gorge. Up this valley the road now passes for some 10 miles in a southerly direction, after which the river is crossed, and a westerly course followed for about a dozen miles up a gradual ascent to the vicinity of The Peaks, now officially known as Yerranderie.

Over this latter distance the denudation has been enormous (Plate xviii.), nearly the whole of the sedimentary formation having been swept away, thereby exposing a porphyritic or felsitic rock, in which some rich silver deposits occur.* On several of the elevated spots are remnants of Upper Marine formation, as indicated by the fossils, which are plentiful in places, amongst others identified by Mr. W. S. Dun being *Spirifer tasmaniensis*, *Martiniopsis subradiata*, and *Merismopteria*. About a mile beyond Yerranderie, towards the head of the Tonalli River, Devonian fossils (*Spirifer disjuncta*) were found in 1905; and these beds were subsequently traced northerly, towards the Kowmung River, where they are tilted at a very high angle.

The Peaks are the remnants of a dissected chain of Permo-Carboniferous cliffs, towards the extreme south-western edge of what is known as the Permo-Carboniferous coal-basin. The highest, or Far Peak, owes its preservation to a small cap of basalt, insufficient, however, to exercise any influence on the surrounding vegetation. Its height is approximately 2,700 feet above sea-level, that of the village being about 2,000 feet. A few miles to the southward of The Peaks, it may be noticed that the sandstone-area gradually disappears, so that the locality marks approximately the south-western margin of those great escarpments known generally as the Blue Mountains. It, therefore, follows that the valley of the Wollondilly, above its junction with the Nattai, though well on the eastern watershed, is rather exposed to dry or western influence, and protected from the damper eastern atmosphere, the consequence being that the flora is, to a slight extent, of a western type, and there is an absence of the brush or jungle so common on the moist, sheltered parts of our coastal rivers, or in the sheltered tributaries of the Kowmung River, just to the north of this area. The locality affords a good example of the influence which aspect exercises upon the growth of forests.

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* See Mineral Resources of New South Wales, p.118, by E. F. Pittman, A.R.S.M.

From Yerranderie, past Colong and Bindook to Mount Werong, the country gradually rises from 2,000 feet to 4,000 feet above sea-level, and the geological formation alternates between felsite and a few hills of Permo-Carboniferous Sandstone, after which, and beyond Bindook, there is a considerable area of Silurian Slate, with some basalt on the highest points, such as Mount Shivering (3,678 feet), and the actual summit of Mount Werong (4,005 feet). Much of the country around Mount Werong, which is on the Great Dividing Range, consists of a granite-plateau, having a general elevation of about 3,900 feet.

George Caley.—The first botanist or collector to visit any part of the area described in this paper, was George Caley (Sir Joseph Banks' seed- and plant-collector), whose exploratory journeys were made in 1802 and 1804, but were confined to that part between Camden and The Oaks, neither of which towns existed at that time. Caley's course, in 1802, was from near Menangle to Picton, and on past Picton Lakes (which he called Scirpus Mere), about a mile, returning thence to the west of Picton, and on a later journey, proceeding westerly to near the head of Stonequarry Creek. From this point, he travelled north-easterly, and then northerly on the eastern side of Werriberri or Monkey Creek (which he named Brush Creek), passing close to where the village of The Oaks now stands, and returning to the Nepean at a point between Cobbitty and Bringelly. Here he crossed, and proceeded in a nearly direct line to Bent's Basin, which locality he termed Dove Dale.* The area roughly bounded by lines joining Camden, Menangle, Picton, and The Oaks, Caley named Vaccary Forest, afterwards known as the Cow Pastures.

Francis Barrallier.—Ensign Francis Barrallier, when trying to find a passage across the Blue Mountains in November, 1802,† passed Menangle and the site of the present town of Picton; and, keeping well to the south of The Oaks, reached the Nattai River, which he followed about six miles to its junction with the Wollondilly. He next proceeded up that river to a point just beyond the junction of the Tonalli, and went thence westerly past the South Peak, Colong, and Bindook Swamp to Gulf Creek, where he turned into the Kowmung River, and up Christy's Creek, until stopped by a waterfall nearly 100 feet high. He records having collected plants just before descending into the Nattai on the 9th November, and about Colong on the 30th November, 1802, though none of the localities beyond Nattai are referred to under their present names.§

The route dealt with in the first part of this paper crosses Caley's track at The Oaks, while the succeeding parts deal largely with the country traversed by Barrallier beyond the Burragorang Valley.

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* See Historical Records of New South Wales, Vol. v., p. 724, with map.

† See Historical Records of New South Wales, Vol. v., p. 749, with map.

§ For detailed account of Barrallier's route, see a paper by the Author, in "The Surveyor," 1910, p. 141.

Rainfall.—According to the records at the Sydney Observatory, the following are the annual rainfalls at some localities surrounding the area described in this paper. Camden 27·8 inches, Picton 29·3, Jenolan Caves 31·8, Oberon 34, Taralga 28·4, and Cox's River, just below Burragorang 28, the average for the whole area being about 30 inches.

Camden to Burragorang.

Between Camden and the junction of the Nattai and Wollondilly Rivers at Burragorang, a distance of about 22 miles, the following plants were recorded:—

RANUNCULACEÆ: *Clematis aristata* R.Br.

DILLENIACEÆ: *Hibbertia dentata* R.Br., *H. diffusa* R.Br., *H. Billardieri* F.v.M., *H. stricta* R.Br.

VIOLARIEÆ: *Ionidium filiforme*, F.v.M.

PITTOSPOREÆ: *Pittosporum undulatum* Vent., *P. revolutum* Ait., *Bursaria spinosa* Cav. (Blackthorn).

POLYGALEÆ: *Comesperma ericinum* D.C.

STERCULIACEÆ: *Lasiopetalum parviflorum* Rudge.

TILIACEÆ: *Elæocarpus reticulatus* Sm., (*E. cyaneus* Ait.), (Blue Berry Ash).

RUTACEÆ: *Boronia ledifolia* J. Gay, *Eriostemon salicifolius* Sm., *E. myoporoides* D.C., *E. hispidulus* Sieb.

STACKHOUSIEÆ: *Stackhousia linarifolia* A. Cunn.

RHAMNEÆ: *Pomaderris apetala* Labill., *P. cinerea* Benth., *P. ligustrina* Sieb.

SAPINDACEÆ: *Dodonæa triquetra* Wendl., (Hop Bush).

LEGUMINOSÆ: *Oxylobium trilobatum* F.v.M., *Gompholobium grandiflorum* Sm., *G. latifolium* Sm., *Jacksonia scoparia* R.Br., (Dogwood), *Daviesia corymbosa* Sm., *D. ulicina* Sm., *Pultenæa stricta* Sims (?), *P. scabra* R.Br., *P. villosa* Willd., *P. flexilis* Sm., *Dillwynia ericifolia* Sm., *D. floribunda* Sm., var. *spinescens*, *Bossiæa lenticularis* Sieb., *B. buxifolia* A. Cunn., *B. rhombifolia* Sieb., *B. scolopendria* Sm., *Hovea longifolia* R.Br., *Indigofera australis* Willd., *Kennedya rubicunda* Vent., *Acacia armata* R.Br., *A. flori-*

bunda Willd., *A. longifolia* Willd., *A. decurrens* Willd., var. *normalis* (Green Wattle), *A. discolor* Willd., *A. juniperina* Willd., *A. penninervis* Sieb., (Local Hickory), *A. suaveolens* Lindl., *A. linifolia* Willd., *A. myrtifolia* Willd., *A. implexa* Benth. (?), *A. elata* A. Cunn. (Cedar Wattle).

ROSACEÆ: *Rubus parvifolius* L.

SAXIFRAGEÆ: *Ceratopetalum gummiferum* Sm., (Christmas Bush), *C apetalum* Don, (Coachwood, Leather Jacket, or Whitewood).

CRASSULACEÆ: *Tillæa verticillaris* D.C.

DROSERACEÆ: *Drosera* sp.

MYRTACEÆ: *Leptospermum flavescens* Sm., *L. stellatum* Cav., *L. attenuatum* Sm., *Callistemon* sp., *Melaleuca hypericifolia* Sm., *M. thymifolia* Sm., *M. linariifolia* Sm., *M. styphelioides* Sm., (Prickly Tea Tree), *Angophora subvelutina* F.v.M., (Apple Tree), *A. intermedia* D.C., and var. *angustifolia* (Apple Tree), *A. lanceolata* Cav., (a so-called Red Gum), *Eucalyptus hemiphloia* F.v.M., (Box), *E. tereticornis* Sm., (Forest Red Gum), *E. crebra* F.v.M., (Narrow-leaved Ironbark), *E. paniculata* Sm., (White or Grey Ironbark), *E. siderophloia* Benth., (Broad-leaved Ironbark), *E. maculata* Hk., (Spotted Gum), *E. quadrangulata* Deane & Maiden, (Brush Box of South Coast), *E. Bosistoana* F.v.M., (Box), *goniocalyx E.* F.v.M., (Mountain Gum), *E. eugenioides* Sieb., (White Stringybark), *E. Macarthuri* Deane & Maiden (Woollybutt), *E. pilularis* Sm., (Blackbutt), *E. Deanei* Maiden (a Blue Gum), *E. corymbosa* Sm., (Bloodwood), *E. piperita* Sm., (Sydney Peppermint), *E. Considenіana* Maiden, *E. Sieberiana* F.v.M., (Mountain Ash), *E. hæmastoma* Sm., (Brittle Gum or Brittle Jack), *E. punctata* D.C., (Grey Gum), *E. resinifera* Sm., (Red or Forest Mahogany), *E. longifolia* Link & Otto, (Sydney Woollybutt), *E. numerosa* Maiden, (Ribbony Gum, River White Gum, or Peppermint), *Tristania laurina* R.Br., (Water Gum), *Syncarpia laurifolia* Ten., (Turpentine), *Backhousia myrtifolia* Hk. & Harv., (Myrtle), *Eugenia Smithii* Poir., (Lilypilly).

UMBELLIFERÆ: *Xanthosia pilosa* Rudge.

ARALIACEÆ: *Astrotricha floccosa* D.C., *A. ledifolia* D.C., *Panax sambucifolius* Sieb.

RUBIACEÆ: *Pomax umbellata* Sol.

COMPOSITÆ: *Olearia ramulosa* Labill., *O. viscidula* Benth., *Brachycome* sp., *Cotula australis* Hk., *Cassinia longifolia* R.Br., *Helichrysum diosmifolium* Don.

STYLIDEÆ: *Candollea serrulata* Labill., *Stylidium graminifolium* Sw., (Trigger-flower).

GOODENIACEÆ: *Goodenia ovata* Sm., *G. barbata* R.Br., (with pale blue flowers), *G. hederacea* Sm., *Scævola hispida* Cav., *Dampiera Brownii* F.v.M., (blue flowers).

CAMPANULACEÆ: *Wahlenbergia gracilis* D.C., (Blue Bell).

EPACRIDEÆ: *Astroloma humifusum R.Br.*, *Brachyloma daphnoides* Benth., (sweet-scented flowers), *Leucopogon muticus* R.Br., *L. ericoides* R.Br., *Acrotriche divaricata* R.Br., *Dracophyllum secundum* R.Br.

PRIMULACEÆ: *Anagallis arvensis* L., (Pimpernel).

JASMINEÆ: *Notelæa longifolia* Vent.

ASCLEPIADEÆ: *Gomphocarpus fruticosus* R.Br., (African Cotton. Introduced).

LOGANIACEÆ: *Mitrasacme polymorpha* R.Br., *Logania floribunda* R.Br.

GENTIANEÆ: *Erythræa australis* R.Br.

SOLANEÆ: *Solanum cinereum* R.Br., *S. pseudo-capsicum* L.

SCROPHULARINEÆ: *Duboisia myoporoides* R.Br.

BIGNONIACEÆ: *Tecoma australis* R.Br., (Wonga Vine).

VERBENACEÆ: *Clerodendron tomentosum* R.Br.

LABIATÆ: *Prostanthera lasianthos* Labill., *P. incana* A. Cunn.

POLYGONACEÆ: *Polygonum minus* Huds.

LAURINEÆ: *Cassytha* sp., (Dodder).

PROTEACEÆ: *Petrophila pulchella* R.Br., *Persoonia ferruginea* Sm., *P. salicina* Pers., (Geebung), *P. linearis* Andr., *Xylomelum pyriforme* Sm., (Wooden Pear), *Lambertia formosa* Sm., (Honey-flower), *Grevillea montana* R.Br., *G. mucronulata* R.Br., var. *angustifolia* (?), *Hakea dactyloides* Cav., *Telopea speciosissima* R.Br., (Waratah), *Lomatia silaifolia* R.Br., *Banksia spinulosa* Sm., *B. serrata* L., (Honeysuckle).

THYMELEÆ: *Pimelea linifolia* Sm.

EUPHORIACEÆ: *Poranthera ericifolia* Rudge, *Amperea spartioides* Brongn., *Phyllanthus Gastræmii* J. Muell., *P. thymoides* Sieb.

URTICEÆ: *Trema cannabina* Lour., *Ficus rubiginosa* Desf.

CASUARINEÆ: *Casuarina glauca* Sieb., (Swamp Oak), *C. suberosa* Ott. & Dietr., (Black Oak), *C. torulosa* Ait., (Forest Oak), *C. Cunninghamiana* Miq., (River Oak).

SANTALACEÆ: *Exocarpus cupressiformis* Labill., (Native Cherry), *E. stricta* R.Br.

ORCHIDEÆ: *Liparis reflexa* Lindl., *Dendrobium* sp.

IRIDEÆ: *Patersonia glabrata* R.Br., (Wild Iris).

LILIACEÆ: *Stypandra glauca* R.Br., *Xerotes longifolia* R.Br., *Xanthorrhœa hastilis* R.Br., (Grass-Tree).

TYPHACEÆ: *Typha angustifolia* Linn., (Bullrush).

FILICES: *Alsophila australis* R.Br., (Tree-Fern), *Adiantum Aethiopicum* L., (Maiden-Hair Fern), *Pteris aquilina* L., (Bracken).*

When leaving Camden, the Wianamatta shale-area was traversed; and, the country having been considerably cleared, only the following large trees were noticed during the first six miles:—*Eucalyptus hemiphloia*, *E. tereticornis*, *E. crebra*, *Angophora subvelutina*, *Casuarina glauca* and *C. Cunninghamiana.*

Acacia glaucescens Willd., occurs plentifully along the banks of the Nepean River.

A. floribunda may be seen along the banks of Werriberri or Monkey Creek (Brush Creek of Caley), just beyond The Oaks;

and, in the month of August, is laden with masses of extremely beautiful flowers. This is one of the Wattles which has its blossoms arranged in spikes instead of little round balls. *A. longifolia*, of which the former is sometimes regarded as a variety, was confined to the sandstone-area, a formation which *A. floribunda* usually avoids, preferring the shale-areas; and the two trees appear to be specifically distinct.

The stately *Acacia elata*, with its broadly pinnate leaves which somewhat resemble those of the common Pepper-Tree (*Schinus molle*), was noticed in the deep gullies beside the descent into Burragorang. Its pinnate leaves have suggested for it the name of Cedar Wattle. This species is well known in the gorges of the Blue Mountains, and, until recently, could be seen from the train at Narara near Gosford.

Angophora subvelutina was confined to the shale-area near Camden, its chief distinguishing characteristic, when compared with *A. intermedia* in the field, being its broad cordate leaves. *A. intermedia*, and its remarkably narrow-leaved variety were noticed at intervals beyond The Oaks, all three being known as Apple-Tree. *A. lanceolata*, a so-called Red Gum, was restricted to the sandstone-formation as usual.

Eucalyptus hemiphloia, the common Grey Box, was found only on the shale-formation, showing its customary aversion to the sandstone.

The various Ironbarks were either on the deep shale, or where the sandstone was thinly coated with shale.

E. maculata, the well-known Spotted Gum, occurs just where the monoclinal fold, already alluded to, has thrown down the shales and exposed the Hawkesbury Sandstone, about four miles before The Oaks is reached. This species, which produces a timber famous for its tensile strength, is widely distributed throughout the coastal districts of New South Wales. By the casual observer, erect trees of *Angophora lanceolata* are sometimes mistaken for *E. maculata*. In going south from Sydney along the Illawarra railway line, the

Spotted Gum is not seen, except for a few trees just beyond Wollongong, until the neighbourhood of Nowra is approached, after which it becomes common, and occurs at many points along the Milton road, such as at The Falls, and beyond Tomerong, where the geological formation is of Permo-Carboniferous age. It is absent, however, from the igneous formation of Milton, but reappears to the south immediately the sedimentary rocks are reached, being plentiful towards Bateman's Bay and also at Wagonga, where some of the very finest specimens of this species may be found. It extends into the north-eastern part of Victoria, but is only very sparsely represented in that State. On parts of the North Coast of New South Wales it is a common tree, and occurs in the Maitland-Singleton district on the Permo-Carboniferous formation in company with *E. crebra*, the Narrow-leaved Ironbark. It extends to within about twenty miles of the Great Dividing Range at Crooked Creek, on the Tenterfield-Casino road. *E. maculata* is decidedly rare, however, in the Sydney district, and generally speaking appears to avoid the Hawkesbury Sandstone formation. There are a few exceptions to this discrimination, one being its occurrence on the sandstone just near the monoclinal fold from The Oaks to the western side of Mulgoa, while others are at Newport, and on the Appin road, about five miles from Campbelltown. At Newport, the Spotted Gum is growing on the rocks which form a remnant of the base of the Hawkesbury Sandstone immediately overlying the Narrabeen Shales; while at The Oaks, and near Campbelltown, it occurs on the top of fairly thick beds of Hawkesbury Sandstone, from which the overlying Wianamatta Shale is, in places, only just barely removed. Observations in regard to the distribution of this species tend to show that it does not seek either a highly siliceous sandstone, or a shale or slate of basic origin, but flourishes best where there is a combination of the two; and while it usually avoids the Hawkesbury Sandstone areas, as too siliceous, it is also absent from the deepest portions of the Wianamatta Shale.

Its occurrence on this latter formation denotes the presence of sand in the vicinity.

E. quadrangulata, *E. Bosistoana*, and *E. goniocalyx* are growing together on the shale-formation about a quarter of a mile on the Camden side of The Oaks. The same association has been noticed at West Dapto; while at Milton, the first two are found on the igneous formation, and the latter occurs in the adjacent mountains of Permo-Carboniferous formation.*

E. Bosistoana might be referred to as the coastal analogue of *E. melliodora* A. Cunn., the western Yellow Box, though the inner bark of the former is white instead of yellow, besides other differences. In the outer bark, the two trees resemble one another in the forest; but although the latter has a very wide range, chiefly in the western areas, the former seems confined to the coastal slopes, and is not regarded as a common box-tree even there. Near Marulan, the two species occur together, on basaltic formation.

The only trees of *E. Macarthuri* noticed, were distributed along the banks of Werriberri Creek, just beyond The Oaks, and in the morning light in June, the foliage was conspicuous through having a faintly bluish tint. This species is usually known as Woollybutt in the Moss Vale district, from the nature of the bark; but the particular trees under discussion have scarcely any of the woolly fibre, being fairly smooth, though the bark is somewhat hard and flaky near the base. This is the most northern point known to me for the species. (For previous remarks on this species see these Proceedings for 1906, p. 434.)

E. pilularis, which produces the well-known and valuable Blackbutt timber of commerce, was seen only just beyond The Oaks, where the shale occurs as a thin coating over the sandstone, and at an altitude of from 1000 to 1100 feet. Although this species is common throughout the coastal districts, north and south of Sydney, it has a limited range in a westerly direction, never ascending far into the mountain-area. There are few Eucalypts whose lateral roots protrude above the surface of the ground more than those of *E. pilularis.*

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* For previous remarks on *E. quadrangulata*, see these Proceedings, 1906, p.437.

E. Deanei is first seen about a mile or so west of The Oaks, just before the margin of the shale is reached, and occurs again near the descent into the Burragorang Valley. It is known as Blue Gum, and gives rise to the name of the creek which flows from Picton Lakes into the Nattai River. Blue Gum Creek is the most southern locality recorded for the species, but it extends northerly to northern New England, crossing at Deepwater, to the western side of the Great Dividing Range, though as a somewhat dwarfed tree known as Brown Gum. Although it continues down the Burragorang Valley, below the junction of the Nattai, and with its beautiful white boles, is one of the most majestic trees in the locality, it does not appear to extend up the Wollondilly above the Nattai Junction, owing perhaps partly to the change of geological formation, after a few miles, from sedimentary to igneous (felsitic), but probably chiefly because of the exposure of this upper area to westerly influence; for, owing to the great amount of denudation up the river and on the western side, the country is more exposed to the cold and drying effect of westerly gales. *E. Deanei* flourishes best under an eastern rather than a western aspect, and it is only in the extreme north, where the atmospheric conditions are tempered by the increased warmth of northern latitudes, that it seems able to cross to the western side of the Main Range.

E. corymbosa, the common coastal Bloodwood, is confined to the sandstone as is usual. There is scarcely any species of Eucalyptus with a more definite partiality for sandstone (siliceous formation), and an aversion for shale or slate areas, than *E. corymbosa;* and if it be found growing on the Wianamatta Shale, the proximity of sandstone and the thinness of the shale, may be confidently deduced. Although a lover of the sandstone, the Bloodwood requires another condition, and that is warmth, for while the Hawkesbury Sandstone extends from Sydney across the Blue Mountains to Lithgow, *E. corymbosa* finds, at about 3,000 feet, that the climatic effect dominates over the consideration of geological formation, and the species becomes rare after the town of Wentworth Falls is passed. The timber of this tree, though containing a number of gum-veins, is well known to possess remarkable qualities for lasting a long time in the ground.

E. Consideniana may be seen on the top of the mountain, on Hawkesbury Sandstone, just before the descent into Burragorang is commenced, and without some inspection is not easily identified. It may be said to have the grey fibrous bark of *E. piperita* (Sydney Peppermint), and the fruits (almost) of *E. Sieberiana* (Mountain Ash). Its juvenile foliage is narrower than that of either, and is arranged vertically like that of the latter and unlike that of the former, which is disposed horizontally.* So far it has always been found associated with *E. piperita* and *E. Sieberiana*, flowering early in November or just after the latter and before the former: and the suggestion that it may have originated as a hybrid between these two species, though extremely difficult of proof, may possibly be correct.†

E. Consideniana seems to have no definite vernacular name, probably owing to the difficulty of its absolute identification by bushmen, but is variously referred to as Peppermint or Messmate, though both of these names are more generally applied to other trees. It is known to occur near Gosford, and on the mountain-top just north of Newnes on the Wolgan River; and extends southerly from these points, occurring intermittently, as far south as Ulladulla, being found on the coast at the latter place, and to within 100 feet of the top of the Pigeon House Mountain to the westward. So far as at present known to me, it always grows on soil derived from either Hawkesbury or Permo-Carboniferous Sandstone, and is an indication of poor agricultural or pastoral country.

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* For description of seedlings of *E. piperita* and *E. Sieberiana*, see these Proceedings 1905, p.195(J. H. Maiden and R. H. Cambage).

† See remarks by J. H. Maiden, these Proceedings 1904, p.477.

E. longifolia (Sydney Woollybutt) was noticed only beyond The Oaks, where a thin coating of shale remains over the sandstone; and although this species is well known in places around Sydney, it is often found growing at the points of contact between the shale and sandstone. *E. longifolia* occurs as far north as near Raymond Terrace, just across the Hunter River; and, in coming southerly, may be seen at such places as Wyong, around the western suburbs of Sydney, Wollongong, Nowra to The Falls, Narrawallee near Milton, Termeil and Bateman's Bay. At the latter place and towards Moruya, it becomes common, being known as Peppermint and Redwood, the latter name being suggested by the colour of the timber. On the Upper Clyde River it is *E. saligna* which is known as Woollybutt. *E. longifolia* continues south into Victoria. It is a coastal tree, and may be readily recognised by its large, somewhat pear-shaped fruits, which are arranged in threes on fairly long pedicels, and have a rather remarkably sculptured rim. The locality now recorded, about five miles west of The Oaks, at an altitude of 1,500 feet, is one of the most distant points from the coast known to me for the species.

E. numerosa, which is known variously as River White Gum, Ribbony Gum, and Peppermint, (the latter name being suggested by the odour of the crushed leaves), is common along the banks of the Nattai River, but was not met with until that point was reached, although it is known to occur along the Nepean River, both above and below Camden. This species was formerly recognised as *E. radiata* Sieber, which latter, Mr. Maiden explains, is only a form of *E. amygdalina* Labill., (These Proceedings, 1904, p. 751). (For previous remarks concerning this tree, see These Proceedings, 1902, p. 574; and 1906, p. 436.)

Syncarpia laurifolia (Turpentine), so widely known in connection with its value as piles in salt water, occurs just beyond The Oaks, or near the margin of the shale. The district bounded by lines roughly joining Picton, The Oaks, Penrith, and the north-eastern side of Parramatta is largely composed of deep beds of what is known as Wainamatta Shale, which overlies the Hawkesbury Sandstone, but becomes shallow, where more denuded on the higher levels outside the margin of this area. Now, it is remarkable that the Turpentine follows practically all round this margin, and also on the isolated outside remnants, as at Springwood, etc., though it rarely encroaches upon the deep shale-area, but ceases when the thickness exceeds about 100 feet. Its presence within this area would indicate the vicinity of sandstone, or at least sandy soil. Its occurrence near The Oaks, therefore, is in keeping with its usual discrimination in regard to selection of geological formations. This species extends northwards into Queensland, and goes south of Sydney to within about a dozen miles of Bateman's Bay. It is of interest to note in connection with its selection of soils, that its terminal point in the south is practically identical with that of the great Permo-Carboniferous coal-basin.*

Casuarina glauca (Swamp-Oak) was noted a few miles from Camden, and was only sparsely represented. This is the common saltwater-oak found all along our coast; but it follows up certain freshwater creeks, which are sluggish and contain brackish water. The presence of this species on the uplands suggests saline conditions. (See these Proceedings, 1901, p. 687).

C. suberosa (Black Oak) was confined to the sandstone-area, a formation to which it is partial, being a lover of siliceous soils.

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* "Climatic and Geological Influence on the Flora of New South Wales." By R. H. Cambage. Report Aust. Assoc. Advt. of Science, 1907, p.476.

C. torulosa (Forest-Oak) occurs around The Oaks, and is the species from which the town derived its name. This tree is easily identified by its fine, pendulous branchlets, which are often very light brown, apart from the colouring given by the presence of male flowers; and the sheath-teeth are only four in number. The flat-topped cones are somewhat melon-shaped, often exceeding one inch long, and even, though rarely, 2¼ inches. The valves protrude only very slightly, consequently the cones have much the same appearance both before and after the seeds are shed, in which feature this species differs from many of the genus. *C. torulosa* has a considerable range from Sydney well into Queensland, but its southern recorded limit is practically around The Oaks and Picton.

In regard to its selection of geological formations, it appears to avoid the extremely acid rocks upon which *C. suberosa* often flourishes; and when these two species are found in the same forest, it will generally be seen that *C. torulosa* has sought out the less siliceous portions, often well drained hillsides. In the Sydney district, therefore, while the former favours the Hawkesbury Sandstone formation, the latter prefers those areas where the sandstone has been mixed with the shale.

In describing Vaccary Forest, Caley evidently refers to *C. torulosa* when he speaks of some of the hills as "abounding with she-oaks," and "making good pasture."

C. Cunninghamiana (River-Oak) occurs on the Nepean River, and on Mount Hunter Rivulet some five miles out, while it is a feature in the landscape on the banks of the Nattai and Wollondilly, and during the droughts of a few years ago was most extensively used as fodder for stock. Unlike *C. glauca,* it never grows on salt-water streams, and its presence is always an indication of good fresh water. In tidal rivers, near the point where the fresh and salt waters meet, the two species may grow within a few chains of each other, without intermingling. *C. Cunninghamiana* is the species to which Barrallier refers where he mentions that "three natives sat under the shade of a she-oak," (Historical Records, v., p. 791).

Stypandra glauca occurs about half a mile above the Nattai, on the old road; and while, in September, many of the plants were covered with the usual beautiful deep blue flowers, three of the adjacent little bushes bore nothing but pure milk-white blossoms.

Burragorang to Yerranderie and Kowmung.

From the junction of the Nattai and Wollondilly Rivers to Yerranderie, is about 20 miles, the road following the valley of the Wollondilly southerly for about halfway, after which it turns westerly, and gradually ascends fairly open felsite-country, thinly capped in places with Upper Marine formation, which on the north and west rises into high escarpments. This open country is what Barrallier referred to, when he reported forest-land beyond Nattai in 1802, and the Blue Gum, Ironbark, and Apple Tree he mentions are *Eucalyptus tereticornis*, *E. crebra*, and *Angophora intermedia* respectively.

The Kowmung River, which is 8 or 10 miles northwesterly from Yerranderie, flows through a deep cañon the depth of which, from the mountain-tops, is from 1,500 to 2,000 feet. The bed, which opposite Cedar Creek is about 1,000 feet above sea-level, is in Silurian slate, upon which are superimposed Devonian quartzites; and these are capped by Permo-Carboniferous sandstones and shales, which, some few miles down the stream, are again covered by Hawkesbury Sandstone. The shelter and seclusion of this profound gorge, provide homes for both plants and birds not seen in the country immediately to the southward.

The plants mentioned in the following list were found between Burragorang, Yerranderie, and the Kowmung River;

and where they may have been already referred to in this paper, the authors' names are not repeated.

RANUNCULACEÆ: *Clematis aristata*, *Ranunculus parviflorus* L. (head of Lannigan's Creek).

DILLENIACEÆ: *Hibbertia linearis* R.Br., and var. *obtusifolia*, (a very narrow-leaved form), *H. volubilis* Andr., *H. diffusa*, *H. Billardieri*.

CRUCIFERÆ: *Cardamine hirsuta L.*

VIOLARIEÆ: *Viola betonicæfolia* Sm., *V. hederacea* Labill.

PITTOSPOREÆ: *Pittosporum undulatum* (South Peak to Colong), *Bursaria spinosa* (Black Thorn), *Citriobatus multiflorus* A. Cunn., (?) (on the Kowmung River), *Billardiera scandens* Sm. (Roly Poly Vine).

POLYGALEÆ: *Comesperma volubile* Labill., (near Byrnes' Gap).

CARYOPHYLLEÆ: *Stellaria pungens* Brongn., (among the basalt on Far Peak).

MALVACEÆ: *Plagianthus pulchellus* A. Gray, var. *tomentosus* (on Lannigan's Creek), *Howittia trilocularis* F.v.M. (South Peak to Colong).

STERCULIACEÆ: *Sterculia diversifolia* G. Don, (not plentiful in this district, except on the limestone), *Commersonia Fraseri* J. Gay (?) (on Kowmung), *Lasiopetalum ferrugineum* Sm.

TILIACEÆ: *Elæocarpus reticulatus* (*E. cyaneus*) (Blue Berry Ash).

RUTACEÆ: *Zieria cytisoides* Sm., (on eastern face of South Peak and in Basin Creek), *Boronia ledifolia* var. *trifoliata*, *B. anemonifolia* A. Cunn., *Correa speciosa* Andr., (Native Fuchsia), *Eriostemon myoporoides* (on Kowmung).

MELIACEÆ: *Cedrela australis* F.v.M., (Cedar or Red Cedar).

RHAMNEÆ: *Pomaderris apetala* (South Peak to Colong), *P.* sp.

SAPINDACEÆ: *Nephelium leiocarpum* F.v.M., (on Cedar and Lannigan's Creeks, Kowmung), *Dodonæa triquetra*, *D. viscosa* L., (Hopbush).

LEGUMINOSÆ: *Oxylobium trilobatum*, *Gompholobium latifolium*, *Jacksonia scoparia* (Dogwood); *Daviesia corymbosa*, *D. ulicina*, *D. acicularis* Sm.; *Pultenæa scabra*, *P. retusa* Sm.; *Dillwynia ericifolia*, *D. juniperina* Sieb., (an unusually pubescent form; towards Byrnes' Gap), *Bossiæa microphylla* Sm.; *Hovea linearis* R.Br., *H. longifolia; Goodia lotifolia* Salisb., (near The Peaks, and at Kowmung); *Indigofera australis; Kennedya rubicunda; Hardenbergia monophylla* Benth., (False Sarsaparilla); *Cassia australis* Sims, *Acacia floribunda* (on the Wollondilly, and the Kowmung), *A. longifolia*, *A. decurrens* var. *normalis*, (Green Wattle, flowering in August at Yerranderie), and var. *mollis*, *A. implexa* (?), *A. Maideni* F.v.M., *A. falcata* Willd., *A. amœna* Wendl., (on banks of Wollondilly and Kowmung), *A. suaveolens*, *A.* sp., (Nos. 2188, 2189, and 2300), *A. Cunninghamii* Hk., *A. discolor*, *A. juniperina*, *A.* sp., (No. 2296), *A. armata*, *A. undulifolia* Fraser, *A. verniciflua* A. Cunn., *A. penninervis*, *A. Jonesii* F.v.M. and Maiden, (near Byrnes' Gap).

ROSACEÆ: *Rubus rosæfolius* Sm., (Wild Raspberry), *R. parvifolius*.

SAXIFRAGEÆ: *Callicoma serratifolia* Andr., (on Butcher's Creek), *Aphanopetalum resinosum* Endl., (Lannigan's Creek), *Ceratopetalum gummiferum* (Christmas Bush).

CRASSULACEÆ: *Tillæa verticillaris*.

DROSERACEÆ: *Drosera auriculata* Backh.

MYRTACEÆ: *Calythrix tetragona* Labill., *Micromyrtus microphylla* Benth., *Bæckea virgata* Andr., *Leptospermum flavescens*, *L. scoparium* Forst., *L. parvifolium* Sm., (near Yerranderie, and on South Peak), *L. stellatum*, *L. attenuatum*, *L. lanigerum* Sm., *Callistemon paludosus* F.v.M., (on banks of Kowmung), *C.* sp., (on South Peak); *Melaleuca thymifolia* (near the Wollondilly), *M. linariifolia*, *M. styphelioides; Angophora intermedia* (Apple Tree); *Eucalyptus*

Sieberiana (Mountain Ash; found on the sandstone hills); *E. amygdalina* Labill., (Peppermint, not common in the locality), *E. numerosa* (Peppermint, on Tonalli River, Church Creek, and western slopes of South Peak), *E. capitellata* Sm., (Brown Stringybark, on sandstone hills), *E. piperita* (Sydney Peppermint, on sandstone hills), *E. melliodora* A. Cunn., (Yellow Box or Yellow-Jacket; on the felsite-formation), *E. hæmastoma* (White or Brittle Gum), *E. hemiphloia* (Grey Box, near the Wollondilly), *E. albens* Miq., (White Box of the Western Slopes; on the felsite), *E. quadrangulata* (Brush Box), *E. siderophloia*, (Broad-leaved Ironbark), *E. crebra*, (Narrow-leaved Ironbark; the commonest Ironbark on the felsite-formation), *E. goniocalyx*, (chiefly on the Permo-Carboniferous shales, and often with *E. quadrangulata*), *E. tereticornis* (Forest Red Gum), *E. punctata* (Grey Gum; chiefly on the sandstone and shales), *E. maculosa* R. T. Baker, (*E. Gunnii* var. *maculosa* Maiden, a gum tree, found only towards the Little Rick), *E. acervula* Miq., (*E. Gunnii* var. *acervula* Deane and Maiden; *E. paludosa* R. T. Baker), *E. corymbosa* (Bloodwood; on the sandstone), *E. eugenioides* (White Stringybark), *E. Wilkinsoniana* R. T. Baker (?) (Stringybark), *E. Muelleriana* Howitt (Stringybark), *E. Smithii* R. T. Baker (towards Kowmung), *Tristania laurina* (Water Gum; on banks of Kowmung).

Umbelliferæ: *Actinotus Helianthi* Labill., (Flannel Flower; on South Peak and north-east of village).

Araliaceæ: *Panax sambucifolius.*

Loranthaceæ: *Loranthus* sp., (on *Eucalyptus tereticornis*).

Rubiaceæ: *Pomax umbellata.*

Compositæ: *Olearia viscidula*, *O. ramulosa*, *Calotis dentex* R.Br., *C. lappulacea* Benth. (?); *Craspedia Richea* Cass., (Bachelors' Buttons), *Cassinia quinquefaria* R.Br., *Humea elegans* Sm., (Native Tobacco; on Basin Creek); *Helichrysum scorpioides* Labill., *H. diosmifolium*, *Senecio lautus* Forst., *S. macranthus* A. Rich., (a very showy plant, about

Basin Creek, flowering in September, and bearing masses of golden-yellow flowers).

Stylideæ: *Candollea serrulata* (*Stylidium graminifolium*, Trigger-Flower).

Goodeniaceæ: *Goodenia ovata, G. hederacea; Dampiera Brownii* (some flowers pure white: usually blue).

Campanulaceæ: *Wahlenbergia gracilis* (Blue Bell).

Epacrideæ: *Astroloma humifusum* (Ground Berries), *Lissanthe strigosa* R.Br.; *Leucopogon lanceolatus* R.Br., *L. virgatus* R.Br., *L. setiger* R.Br., *L. muticus, L. ericoides; Acrotriche divaricata, Monotoca scoparia* R.Br., *Epacris microphylla* R.Br.

Myrsineæ: *Rapanea Howittiana* Mez., (Brush tree on Basin, Cedar and Lannigan's Creeks).

Jasmineæ: *Notelæa longifolia.*

Asclepiadeæ: *Marsdenia suaveolens* R.Br., *Gomphocarpus fruticosus* (introduced).

Gentianeæ: *Erythræa australis.*

Solaneæ: *Solanum* sp.

Scrophularineæ: *Duboisia myoporoides.*

Bignoniaceæ: *Tecoma australis* (Wonga Vine).

Verbenaceæ: *Chloanthes stœchadis* R.Br., (green flowers), *Clerodendron tomentosum.*

Labiatæ: *Plectranthus parviflorus* Willd., (blue flowers; on rocks).

Plantagineæ: *Plantago varia* R.Br.

Polygonaceæ: *Polygonum minus* (at Kowmung), *Muhlenbeckia adpressa* Meissn., (Basin Creek).

Monimiaceæ: *Doryphora sassafras* Endl., (Sassafras; Kowmung).

Laurineæ: *Cassytha paniculata* R.Br., (Dodder).

Proteaceæ: *Petrophila pulchella; Isopogon anethifolius* R.Br., (South Peak), *I. anemonifolius* R.Br.; *Persoonia ferruginea, P. salicina* (Geebung), *P. linearis* (Geebung); *Grevillea obtusiflora* R.Br., (up to 12 feet high; on Basin Creek), *G. arenaria* R.Br., (Cedar Creek, Kowmung); *Hakea saligna*

R.Br., *H. acicularis* R.Br., *H. microcarpa* R.Br., *H. dactyloides; Lomatia longifolia* R.Br., *L. silaifolia; Banksia spinulosa, B. marginata* Cav., *B. serrata* L., (Honeysuckle; on top of The Peak).

THYMELEÆ: *Pimelea linifolia, P. ligustrina* Labill., (on Kowmung).

EUPHORBIACEÆ: *Poranthera corymbosa* Brongn., *Amperea spartioides, Phyllanthus thymoides, Breynia oblongifolia* J. Muell., *Omalanthus stillingiæfolius* F.v.M., (*Carumbium stillingiæfolium* Baill.; Basin Creek).

URTICEÆ: *Trema cannabina; Ficus rubiginosa, F. aspera* Forst., (Cedar and Lannigan's Creek); *Urtica incisa* Poir., (Nettle); *Laportea gigas* Wedd., (Stinging Tree; Lannigan's Creek).

CASUARINEÆ: *Casuarina Cunninghamiana* (River Oak), *C. stricta* Ait., (*C. quadrivalvis* Labill.; Sheoak); *C. torulosa* (Forest Oak; abundant in The Gap, near South Peak), *C. suberosa* (Black Oak), *C. nana* Sieb., (Dwarf Oak; on South Peak).

SANTALACEÆ: *Santalum obtusifolium* R.Br., *Leptomeria acida* R.Br., (Native Currant), *Exocarpus cupressiformis* (Native Cherry), *E. stricta.*

ORCHIDEÆ: *Liparis reflexa* (growing on rocks, near Basin Creek, Cedar Creek, and on eastern face of South Peak), *Dendrobium speciosum* Sm., (Rock-Lily), *Pterostylis curta* R.Br., *Cyrtostylis reniformis* R.Br., *Caladenia cærula* R.Br.

TRIDEÆ: *Patersonia* sp., *Libertia paniculata* Spreng.

LILIACEÆ: *Eustrephus latifolius* R.Br.; *Stypandra glauca* (quite a feature on the top of South Peak, with its masses of charming blue flowers); *Xerotes longifolia* (with very short, subulate, rigid bracts; Byrnes' Gap), *X. flexifolia* R.Br., *X. glauca* R.Br.; *Xanthorrhœa hastilis* (Grass-Tree).

CYPERACEÆ: *Schoenus ericetorum* R.Br., *Lepidosperma concavum* R.Br., *L. filiforme* Labill., *Caustis flexuosa* R.Br., (Curly Wig).

GRAMINEÆ: *Themeda Forskalii* Hack., (*Anthistiria ciliata* L., Kangaroo-Grass), *Stipa verticillata* Nees, (Wiro-Grass), *Arundo Phragmites* Dod., (in Basin Creek).

FILICES: *Todea barbara* T. Moore, (along Butchers Creek), *Alsophila australis* (Tree Fern), *Lindsaya microphylla* Sw., *Adiantum Aethiopicum* (Maiden-Hair Fern), *A. formosum* R.Br., (Giant Maiden-Hair; Cedar Creek), *Cheilanthes tenuifolia* Sw., *Peters aquilina* (Bracken), *P. falcata* R.Br., *Blechnum cartilagineum* Sw., *Doodia aspera* Mett., *Asplenium flabellifolium* Cav., *Polystichum aculeatum* Sw., (*Aspidium aculeatum*).

Cedrela australis (Cedar or Red Cedar), so widely known for its most valuable timber, occurs in Cedar Creek, and several more of the almost inaccessible tributaries of the Kowmung. The conditions which this species demands, in order that it may produce its finest growths, are shelter, moisture, warmth, and a soil which does not contain a high percentage of silica. Consequently it is found on good land, and confined to the coastal area in Queensland and New South Wales. The most southern Cedar tree known to me, is at Tillowrie, about two miles south of Milton. The Cedar played an important part in the development of early Australia, for many a country settlement, both on the North and South Coast, was formed by the hardy pioneers who went forth to secure this valuable timber.

Acacia Maideni was noticed about 2½ miles west of the Wollondilly bridge, and, in the absence of flowers, which are arranged in spikes, may often be confused with *A. implexa*. It is a coastal species, occurring around Sydney, and at Milton is well known under the name of Sally. A young Sally is a handsome and graceful-looking tree, but soon after maturity it becomes infested with the galls of a small wasp, which has been identified by W. W. Froggatt as *Trichilo-*

gaster Maideni Froggatt, and these galls soon cover the smaller branches, and finally quite disfigure the tree.

A. Cunninghamii is locally called Myall, but is not to be confused with the Myall of the western districts (*A. pendula*). A little occurs a few miles south-easterly from Yerranderie, on felsite, but an abundance may be seen on the slope to the Kowmung around the head of Cedar Creek, on the Devonian formation. This species very closely resembles *A. glaucescens* of the Nepean and George's Rivers, but has more angular branchlets, and although chiefly a northern species, is common at Tolwong, on the steep slopes of the Shoalhaven River.

A species of Acacia (Nos. 2188, and 2300) somewhat resembling *A. adunca* A. Cunn., was found just on top of Byrnes' Gap (2,000 feet) on Permo-Carboniferous formation, and is the species, No. 1622, referred to by me from Torrington, near Deepwater, and then not indentified. (These Proceedings, 1908, p. 53). At Byrnes' Gap it grows about 6-8 feet high, with reddish, angular branchlets, and linear, one-nerved phyllodia, having sometimes recurved, and at others, straight points. On 7th June, 1909, it was opening into flower; and, on 7th October, young, long, narrow pods had formed. As seen growing, it somewhat resembles *A. retinodes* Schlecht., of South Australia and Victoria.*

A species of Acacia (No. 2296) is growing abundantly with *A. Cunninghamii*, on Devonian quartzite, and Silurian slate around the head of Cedar Creek, and extending down towards the Kowmung, between altitudes of 1,100 and 2,000 feet. It has the facies of *A. prominens*, with phyllodia up to about 1½ inches long, 2-3 lines broad, often with hooked tips, but the one marginal gland is much less prominent than in *A. prominens*. Its tomentose phyllodia give the plants a somewhat greyish appearance in the forest. In June, it was not in bud, and the specimens then collected are whitish towards the ends of the young phyllodia; while, in October, it was flowering, but no pods had formed; and the plant has not been identified.

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* Ripe pods were obtained in December, 1911, but the species has not been identified. [*Postcript, added Jan. 12th, 1912.*]

A. Jonesii is growing near Byrnes' Gap, north of Yerranderie, as a very small Wattle, about 18 inches high, with finely pinnate leaves.* This is apparently a somewhat rare species, the type of which came from near Marulan.

Eucalyptus melliodora, the Yellow Box of the west, may be seen soon after the Wollondilly is crossed; and its presence suggests that the locality is, to some extent, open to western influence. This species, however, is very versatile, and able to withstand considerable extremes of heat and cold, although it is rarely found where the full moist coastal influence operates.

Associated with the Yellow Box, is *E. albens*, the White Box of the Western Slopes, and I do not know of its occurence nearer Sydney. This may justly be regarded as the western analogue of *E. hemiphloia*, the common Box of Parramatta. It seems fair to assume that this is an instance of two forms, which may have been originally one and the same species prior to the latest considerable uplift of Eastern Australia, in late Tertiary or Pleistocene time.† That elevation created a "natural barrier," the Great Dividing Range, between the moist climate of the coast, and the dry climate of the west. With its steep eastern side facing the ocean, and its long slopes turned to the dry west, this Great Divide furnished the conditions necessary to establish two aspects totally opposite in character. A species which survived on both sides, would gradually develop features in response to its surroundings, which, in course of time, would be considered sufficiently distinctive to warrant each form in having specific rank. There would be a period, however, in the stage of development, when it would be difficult to decide whether the characters were sufficiently modified to justify each form being regarded as a species. The decision would depend greatly on the point of view of the botanist concerned, that is, on his conception of what a species really is. In just about such a transition-stage do *E. hemiphloia* and *E. albens* now appear to be, for botanists are not agreed as to whether or not one of these trees is a variety of the other. As *E. hemiphloia* was the first described, it is *E. albens*, which, according to botanical practice, would be regarded as the variety by those who could not accept both as species; while, as a natural fact, it would seem that *E. albens* is the western or dry-country form of *E. hemiphloia*, and *E. hemiphloia* is the eastern or moist-country form of *E. albens*. It is not difficult to separate the typical large-fruited, somewhat glaucous, western form of *E. albens* from the greener and smaller-fruited coastal form of *E. hemiphloia;* but, in areas, like portions of the Upper Wollondilly, or Upper Hunter, where the Main Range is slightly lower, and western atmospheric conditions come eastward, and there is a toning off or blending of both moist and dry conditions, the line of demarcation between these two box-trees is much less pronounced. The same remarks apply to areas on northern New England, as at Stannum, where, owing to warmer latitudes, the Main Divide does not provide such a decided cold barrier as in the south, and the distinctive effect of eastern and western aspects diminishes as Queensland is entered.

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* Some plants were seen in December, 1911, from 3 to 5 feet high.

† "Geographical Unity of Eastern Australia," by E. C. Andrews, B.A. Journ. and Proc. Roy. Soc. N. S. Wales, 1910, p.420. Presidential Address by C. Hedley, F.L.S., these Proceedings, 1911, p.13.

E. hemiphloia and *E. albens* afford an excellent field for the study of the development of the great genus Eucalyptus. *E. albens* occurs over practically the whole of the western slopes, while *E. hemiphloia* is found intermittently over the whole of the coastal area.

E. quadrangulata, the Brush Box of the South Coast, occurs plentifully under The Peaks, and especially near the track passing the South Peak towards Colong, which is about the most western point reached by this species. It is easily distinguished, in the forest, from other box-trees, such as *E. albens*, by its fine, erect boles, which, together with its branches, are covered with grey box-bark. Its juvenile foliage and "suckers" are characteristic, being rather long, cordate and opposite, on quadrangular stems.

E. maculosa, a rather small-fruited, white gum, was noticed towards the edge of the Permo-Carboniferous formation, east of the Square Rock, or Little Rick, which marks a point on the eastern margin of its habitat. It is first met with, on the Western Railway Line, at a few hundred yards beyond the Wentworth Falls Station. On the western side of the Mountain Area, it is a fairly common tree from Rylstone southwards, but rarely comes below an altitude of 2,000 feet on the coastal side, or about 1,500 feet on the western side.

E. acervula occurs around Byrnes' Gap, and towards Colong, and is known as Swamp-Gum. It is a common gum-tree in Tasmania, where it is usually called Red Gum. It comes north through Victoria and southern New South Wales, keeping in the Mountain Area in this State, and usually selecting the damp valleys for its home, hence Mr. Baker's name, *E. paludosa*. It shares with *E. pilularis* the characteristic of having large, lateral roots, which protrude above the surface of the ground. These two species do not grow together, however, *E. acervula* keeping on the higher country. The locality around Byrnes' Gap, and Butcher's Creek, just north of Yerranderie, is the most definite northern spot known to me for the species. In its selection of soils, the Swamp Gum appears to avoid that which is extremely siliceous; and it is, perhaps, owing to this fact, that its northern limit is restricted to the locality just mentioned. Yerranderie is about the southern margin (west of the Wollondilly) of the Hawkesbury Sandstone, an extremely siliceous rock, and it would seem that the Swamp-Gum finds this formation too acid; for it is significant that, although it continues for some distance among the sandstone hills, it does not occur upon them, but is confined to the valleys which have been denuded through them into the less acid soils made up of Permo-Carboniferous shales and sandstones. It seems probable, therefore, that it is a southern species, whose northerly progress has been checked by this large area of highly siliceous Hawkesbury Sandstone-formation. *E. acervula* is readily identified, in the field, by its rather large "sucker" leaves, its green, undulate, mature foliage, and its truncated, obconical fruits.

E. Smithii was noticed on Devonian quartzites near Cedar Creek, also near Lannigan's Creek and towards Mount Shivering. In this latter locality, which is the most inland and elevated known to me for the species, it was growing on Silurian slate-formation, at an altitude of 3,000 feet. From the Kowmung, it extends southerly past Mittagong, Mount Kembla, and Kangaroo Valley to the Braidwood district; and is much valued for the excellent oil that it yields.* It usually selects somewhat sheltered hillsides, and in the lower part of the bole resembles an Ironbark or the Mountain Ash (*E. Sieberiana*), owing to its dark, rough, deeply furrowed bark, which tones off to smooth, often ribbony, on the upper parts. Its fruits resemble those of *E. viminalis*, and may sometimes be confused with them, when the latter species is multiflowered instead of having the usual trifloral arrangement; but generally the fruits of *E. Smithii* have a more domed appearance, owing to the broad rim being forced outwards as the fruits ripen. As a rule, the two species are not found together, the open forest-land being usually selected by *E. viminalis*, which is also more of a cold country type, and prefers soils derived from more basic rocks than does *E. Smithii.*

Just east of the Hotel near Wollondilly Bridge, on Permo-Carboniferous formation, a few Stringybarks were noticed, which appeared to have affinities with *E. eugenioides* and *E. Muelleriana;* and, from the incomplete material obtainable, may be *E. Wilkinsoniana* R. T. Baker. The few fruits procured have red rims.

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* See "A Research on the Eucalypts," by R. T. Baker, F.L.S., and H. G. Smith, F.C.S., p 107.

Persoonia linearis, a Geebung, is distributed throughout this country, and around Colong is regarded as good sheep-fodder in times of drought. *P. salicina* is also considered fairly valuable for the same purpose.

Colong to Mount Werong.

Colong is situated at five miles south-westerly from Yerranderie, at an altitude of about 2,000 feet; and Mount Werong is a further distance of nearly 25 miles in a general westerly and north-westerly direction, the bridle-track ascending to a plateau about 3,900 feet above sea-level. The route followed was through Barrallier's Pass, south of Colong Mountain,(3,436 feet) and Bindook Swamp, to a narrow spur, which divides the waters of the Wollondilly (Gulf Creek) on the south from those of the Kowmung on the north, the deep gorge of the latter sometimes coming into view, 2,000 feet below. The last few miles are practically level, and this locality is the home of many of our cold-region plants, amongst others of interest found there being a new species of Zieria.

In addition to the felsite, Permo-Carboniferous sandstone, Silurian slate, and granite passed, in the order named, a belt of limestone crosses under the Silurian slate, but is exposed, on both sides of the range, in Gulf and Lannigan's creeks, where considerable denudation has taken place. Its effect on the flora is at once apparent, more particularly at the lower levels, owing to the presence of *Sterculia diversifolia* (Currajong), which always shows a preference for limestone-soils.

As many of the plants around Yerranderie and Colong favour the sandstone rather than the felsitic area, the following rock-analysis, taken from the Mines Department's Annual Report, 1909, will be of interest. It may be mentioned that, from an œcological standpoint, a rock containing less than 70% silica is not considered remarkably acid.

ANALYSIS OF QUARTZ-FELSITE FROM COLONG (YERRANDERIE).

	per cent.
Silica	63·54
Alumina	15·07
Ferric oxide	1·90
Ferrous oxide	3·51
Magnesia	2·82
Lime	3·10
Soda	2·49
Potash	3·15
Water (110°C)	0·22
Water (110°C+)	2·40
Carbon dioxide	1·32
Titanium dioxide	0·55
Zirconium dioxide	absent
Phosphoric anhydride	0·13
Sulphuric anhydride	absent
Chlorine	absent
Fluorine	—
Sulphur(FeS$_2$)	absent
Chromium sesquioxide	absent
Nickel and Cobalt protoxide	absent
Manganous oxide	0·08
Baryta	0·11
Strontia	‡trace
Lithia dioxide	‡present.
Vanadic oxide	trace (less than 0·01 %).
	100·39

‡ Spectroscopic reaction only. Specific gravity—2·701.

This quartz-felsite is the rock referred to by Barrallier as granite and blue granite; and the sample from which the above constituents were obtained, came from the exact locality where he records, on the 30th November, 1802, as follows:—"During this day I picked up a quantity of new plants."[*]

Between Colong and Mount Werong, the following plants were noted by me:—

RANUNCULACEÆ: *Clematis aristata.*

DILLENIACEÆ: *Hibbertia volubilis, H. serpyllifolia* R.Br., (on the Big Plain, east of Mount Werong), *H. linearis* var. *obtusifolia.*

VIOLARIEÆ: *Viola betonicæfolia, V. hederacea.*

PITTOSPOREÆ: *Marianthus procumbens* Benth.

CARYOPHYLLEÆ: *Stellaria pungens.*

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[*] Historical Records, New South Wales, Vol. v., pp.793, 795, 807.

Tiliaceæ: *Elæocarpus reticulatus* (Blue-Berry Ash).

Rutaceæ: *Zieria robusta* Maiden and Betche, *Boronia anemonifolia* (on sandstone; north of Bindook Swamp).

Rhamneæ: *Pomaderris ferruginea* Sieb., *P. phillyreoides* Sieb., *P. apetala*, *P. ligustrina; Cryptandra amara* Sm.

Ampelideæ: *Vitis hypoglauca* F.v.M., (Wild Grapes; in Barrallier's Pass).

Leguminosæ: *Oxylobium trilobatum*, *Gompholobium virgatum* Sieb., (at Mount Werong), *Daviesia corymbosa* (narrow-leaved form), *D. ulicina; Pultenæa stricta* Sims (?) (No. 2243); *Dillwynia floribunda* var. *spinescens*, *Platylobium formosum* Sm., (head of Bindook Swamp); *Bossiæa prostrata* R.Br., (near Bindook Swamp), *Hovea linearis*, *Indigofera australis*, *Glycine clandestina* Wendl., (a small, twining plant, with pale blue flowers, on the felsite, at Colong), *Hardenbergia monophylla* (False sarsaparilla), *Acacia juniperina*, *A. vomeriformis* A. Cunn., (a small, prostrate, prickly plant, at Mount Werong), *A. verniciflua* A. Cunn., *A. penninervis*, (called Hickory, at Colong; large trees), *A. obtusata* Sieb., *A. suaveolens*, *A. melanoxylon* R.Br., (Hickory, at Mount Werong), *A. longifolia*, *A. discolor*, *A. decurrens* var. *mollis*, and var. *normalis*, *A. dealbata* Link (Silver Wattle; growing on the top of Mount Werong Trig. Station).

Saxifrageæ: *Quintinia Sieberi* DC. (in heads of gullies).

Crassulaceæ: *Tillæa verticillaris*.

Myrtaceæ: *Calythrix tetragona*, *Micromyrtus microphylla*, *Bæckea Gunniana* Schauer (at Mount Werong, and in Bindook Swamp); *Leptospermum flavescens* (Tea-Tree), *L. scoparium*, *L. lanigerum*, *L. stellatum*, *L. myrsinoides* Schl., *L. sp.* (No. 2258); *Callistemon lanceolatus* DC., (with red flowers, Bottle Brush), *C. Sieberi* DC., *Melaleuca linariifolia* (a paper-barked Tea-Tree, near Aboriginal sharpening-stones at head of Bindook Swamp); *Eucalyptus stellulata* Sieb., (Black Sally), *E. coriacea* A. Cunn., (Snow Gum, of Kosciusko), *E. Sieberiana* (Mountain-Ash; not on the felsite), *E. amygdalina* (Peppermint), *E. dives* Schauer (on the felsite, opposite

Colong Woolshed; Peppermint), *E. obliqua* L'Hér., (Messmate; at Mount Werong), *E. aggregata* Deane and Maiden (on the flats around the lower end of Bindook Swamp), *E. stricta* Sieb., (growing like a Mallee on flat sandstone hilltops, and very plentiful on the Big Plain), *E. fastigata* Deane and Maiden, (*E. regnans* F.v.M., according to Mr. J. H. Maiden, locally called Blackbutt at Barrallier's Pass), *E. Smithii* (in Barrallier's Pass, and towards Mount Shivering), *E. punctata* (Grey Gum), *E. crebra* (Ironbark), *E. eugenioides* (White Stringybark), *E. capitellata* (Brown Stringybark; in Barrallier's Pass), *E. Muelleriana* (Stringybark, towards Bindook Station, also on Kowmung), *E. rubida* Deane and Maiden (*E. Gunnii* var. *rubida* Maiden; a White Gum, with opposite, orbicular, juvenile foliage), *E. acervula* (Swamp-Gum), *E. maculosa*, *E. viminalis* Labill., (Manna-Gum), *E. Bridgesiana* R. T. Baker (one of the trees recognised by Baron von Mueller as *E. Stuartiana* F.v.M.; the name is still retained by Mr. Maiden; found with *E. dives* on the felsite-formation, opposite the Colong Woolshed, and at Bindook), *E. tereticornis* (at Colong only).

Umbelliferæ: *Actinotus Helianthi* (Flannel-Flower).

Loranthaceæ: *Loranthus pendulus* Sieb., (parasite on *Eucalyptus amygdalina* and *E. stricta*).

Araliaceæ: *Panax sambucifolius*.

Rubiaceæ: *Coprosma hirtella* Labill., (at Mount Werong), *Pomax umbellata, Galium umbrosum* Sol.

Compositæ: *Olearia myrsinoides* Labill., *Craspedia Richea*, *Cymbonotus Lawsonianus* Gaud.

Goodeniaceæ: *Goodenia ovata, G.* sp.; *Dampiera Brownii, D. stricta* R.Br.

Epacrideæ: *Brachyloma daphnoides; Leucopogon lanceolatus, L. microphyllus* R.Br., *L. muticus, L. ericoides, L. biflorus* R.Br., *L. Fraseri* A. Cunn.; *Acrotriche divaricata; Monotoca elliptica* R.Br. (?), *M. scoparia* (up to 3,900ft.); *Epacris paludosa* R.Br., *E. heteronema* Labill., *E. microphylla, E. purpurascens* R.Br., (on Big Plain).

JASMINEÆ: *Notelæa longifolia, N. microcarpa* R.Br., (at Colong).

SCROPHULARINEÆ: *Veronica Derwentia* Andr.

LABIATÆ: *Plectranthus parviflorus; Prostanthera lasianthos* Labill., (Wild Lilac), *P. saxicola* R.Br., (on sandstone-plateau, north of Bindook Swamp, at an altitude of 2,800 feet); *Hemigenea purpurea* R.Br., (?) (no flowers; on the Big Plain).

PROTEACEÆ: *Isopogon anethifolius; Persoonia ferruginea, P. linearis, P. oxycoccoides* Sieb., (at Mount Werong; almost prostrate; with small, ovate leaves about 3 lines long); *Grevilla laurifolia* Sieb.; *Hakea saligna* (in Barrallier's Pass), *H. microcarpa* (in swampy places), *H. dactyloides; Lomatia ilicifolia* R.Br., *L. longifolia, L. silaifolia* (a so-called Parsley Fern); *Banksia spinulosa B. marginata* (at Colong, and on granite at Mount Werong), *B. serrata* (Honeysuckle; north of Bindook Swamp, on sandstone, at 2800 feet).

THYMELEÆ: *Pimelea linifolia, P. ligustrina.*

EUPHORBIACEÆ: *Amperea spartioides.*

CASUARINEÆ: *Casuarina suberosa* (Black Oak), *C. nana, C. paludosa* Sieb., (near head of Bindook Swamp).

SANTALACEÆ: *Choretrum spicatum* F.v.M., *Omphacomeria acerba* DC., *Exocarpus cupressiformis* (Native Cherry), *E. stricta.*

ORCHIDEÆ: *Dendrobium speciosum* (Rock-Lily; on sandstone-peak, near Bindook); *Caladenia carnea* R.Br., *C. alba* R.Br.

LILIACEÆ: *Xerotes longifolia, X. flexifolia, X. glauca; Xanthorrhœa hastilis* (?) (Grass-Tree).

JUNCACEÆ: *Luzula campestris* DC.

CYPERACEÆ: *Heleocharis sphacelata* R.Br., (reed-beds in Colong Creek), *Schœnus ericetorum, Lepidosperma concavum, Gahnia trifida* Labill., (growing as tussocks, on the Big Plain), *Caustis flexuosa* (Curly Wig), *Carex Gaudichaudiana* Kunth (in Colong Creek).

GRAMINEÆ: *Arundo Phragmites* Dod., (in Colong Creek), *Poa cæspitosa* Forst., (tussocks, in Barrallier's Pass).

FILICES: *Gleichenia dicarpa* R.Br., (Braid or Bead Fern), *Todea barbara*, *Alsophila australis* (Tree-Fern), *Adiantum Aethiopicum* (Maiden-Hair Fern), *Hypolepis tenuifolia* Bernh., *Cheilanthes tenuifolia*, *Pteris aquilina* (Bracken), *Blechnum cartilagineum*, *Doodia aspera*, *Asplenium flabellifolium*, *Polystichum aculeatum* (*Aspidium aculeatum*; on top of Mount Werong), *Dryopteris tenera* (R.Br.) C.Chr., (*Aspidium tenerum* Spreng.; common from 3000 to 3600 feet).

An interesting little Hibbertia(No 2259), which may be a form of *H. serpyllifolia*, or possibly a new species, was found on the Big Plain, at an altitude of about 3,800 feet. The plants were only about six inches high, having narrow linear leaves, under two lines long, with slightly recurved margins, and faintly ciliate on the edges. On 4th October, 1909, no flowers were procurable, and all the very young buds, just forming, appeared to be terminal.

Sterculia diversifolia (Currajong) was not noticed between Colong and Mount Werong, the elevation near the track probably being too great for it. On the belt of limestone at lower levels, it is a conspicuous tree, especially at Church Creek, a tributary of the Kowmung. This is a species which flourishes very much better on soils derived from basic rather than siliceous rocks, and distinctly seems to prefer a soil having a high percentage of lime. It is, therefore, rare on sandstone, fairly common on basalt and allied rocks, and plentiful on limestone. In localities south of Sydney, it is rarely found at altitudes exceeding 2,200 feet, as it avoids the cold country, and neither this species nor the genus is represented in Tasmania.

A new species of Zieria was found near Mount Werong, which has since been described as *Z. robusta* Maiden and Betche (these Proceedings, 1910, p.788). Just east of Mount Werong, is a headland locally known as South Head, to the west of the Big Plain (3,800 feet) and overlooking part of Ruby Creek gorge.

The situation seemed similar to that just west of Blackheath, where *Eriostemon obovalis* A. Cunn., is growing, and while unsuccessful search was being made for that plant, a new species of the same Family, *Z. robusta,* was found. This little shrub is about 18 inches high, with trifoliate leaves and obovate leaflets, and is not unlike an Eriostemon in habit.

A Pultenæa (No.2243), which seems most nearly allied to *P. stricta,* was collected at Mount Werong, but it differs very much in habit from that species as commonly seen, being practically prostrate. The same form has been found previously at Kybean (No.1989), and at Mongarlowe near Braidwood (No.2058). At Kybean and Mount Werong, it is growing on granite-formation, at altitudes exceeding 3,500 feet.

Acacia verniciflua was noted, at intervals, between Mount Shivering and Mount Werong, its identification being assisted by its viscid and prominently two-nerved phyllodia. It is a tall shrub, with a fairly wide distribution. In Tasmania, on the roadside between Fern Tree and The Springs, it is a conspicuous and charming shrub, with its dense graceful heads of bright green foliage. In many parts of New South Wales, it has more of a sparse habit.

An interesting Leptospermum (No.2258) was noticed on the Big Plain, at an altitude of about 3,800 feet; but on the 4th October, 1909, no flowers were procurable, and the species has not been identified. The plants are almost prostrate, in masses about one foot high, and have sweet-scented leaves, about two lines long.

Callistemon lanceolatus was found near the head of Bindook Swamp, close to the flat rock where the Aborigines formerly sharpened their tomahawks; and *C. Sieberi* is growing in damp places at Mount Werong.

Melaleuca linariifolia (Tea-Tree) was seen near the head of Bindook Swamp, at an altitude of about 2,600 feet, but not beyond that point. On various occasions, it has been noticed that the genus Melaleuca seems to avoid the mountain-area in this State; and while we have nearly twenty species in New South Wales, the bulk of these flourish much below an elevation of 2,000 feet. In Tasmania there are only five species recorded by L. Rodway (The Tasmanian Flora).

Eucalyptus stellulata (Sally or Black Sally) is growing on the quartz-felsite at Colong, at an elevation of about 1,900 feet, and at Bindook Swamp, but was not seen on the rougher part of the mountain, towards Mount Werong, owing to the situation not being favourable, but is known to occur plentifully beyond that locality towards Oberon. Next to *E. coriacea*, this is, perhaps, the most typical cold-region Eucalypt in New South Wales, flourishing in the mountain-area throughout its whole length, especially on the open, damp land or creek-flats, and extending into Victoria. Curiously, however, this species is not known to occur in Tasmania.

E. coriacea, the Snow Gum of Kosciusko, first appeared at Bindook Swamp, and again around Mount Werong.

E. obliqua (Messmate) is common in Tasmania, and extends through Victoria to the eastern margin of New England, and to Wilson's Downfall, on the Queensland border. In this State, however, it occurs only intermittently, chiefly in the mountain-area; and its discovery at Mount Werong helps to link up the previously known localities. It has a fibrous, somewhat stringy bark, and fruits with a very thin rim, and deeply sunken valves; while the leaves often have the midrib arranged obliquely, hence the specific name. This latter feature is, however, by no means restricted to this species.

E. Sieberiana, commonly known as Mountain-Ash, was seen on the sandstone areas throughout. This tree selects soils derived from siliceous rocks, and, in New South Wales, occurs on both the coastal and mountain-areas; but, on the latter, it prefers the eastern or moist aspect to the western or dry side. In the Sydney district, it is abundant on the Hawkesbury Sandstone-formation, but absent from the more basic portions of the Wianamatta Shale-area. In some situations, it grows into large trees, 100 feet high; while, in others, it is dwarfed to 10 feet, with clean white stems, and assumes a mallee-like form, as on the mountain north of the Wolgan River Shale Mine, and also near Heathcote and Lindfield. When exposed near the seashore, as at Long Bay, it may be seen matured at 5-6 feet high. This species occurs on the north-east coast of Tasmania, where it is known as Ironbark, and from which railway sleepers are cut for export, though in New South Wales there are many very much better timber-trees.* Near the ocean, at Scamander, it becomes dwarfed in a similar manner to that noticed at Long Bay, near Sydney, without, however, assuming a mallee-like form in either case.

Although *E. viminalis* was not seen between Camden and Colong, it is known to occur on the Nepean, both above and below Camden.

E. aggregata, a species with remarkably small, clustered fruits, and slightly fibrous to flaky bark, is growing on the lower portion of the Bindook Swamp, which is one of its nearest points to the coast. From the Orange-Wallerawang district in the north, to the Upper Shoalhaven in the south, it occurs in open, somewhat damp situations, with *E. stellulata*; but, so far, its range is not known to extend beyond these limits, its place on the Kybean river in the south, where *E. stellulata* is plentiful, being taken by *E. parvifolia* Cambage, a species with which it has some affinities. (For previous remarks, see these Proceedings, 1902, p 581).

E. fastigata, the Blackbutt of the Oberon-Jenolan Caves Road, was noticed at Barrallier's Pass, near Colong, and at Mount Werong. This tree is closely allied to, if not a form of, *E. regnans* F.v.M., of Victoria and Tasmania.† *E. fastigata* has rough, fibrous bark right up to, and often on the branches; while, above 10 or 12 feet, the boles of *E. regnans* are usually smooth. The fruits of *E. fastigata* are somewhat pear-shaped, and generally slightly domed; while those of *E. regnans*, as seen in Victoria and different parts of Tasmania, appear to be constantly truncate. These latter trees, in Tasmania, occupy more sheltered areas in the brush-country than those usually selected by *E. fastigata* in

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* See "The Forest Flora of New South Wales," by J. H. Maiden. Part xxxiv., p.47.

† See "A Critical Revision of the Genus Eucalyptus," by J. H. Maiden. Part viii.

New South Wales, and are known as Swamp Gum, a rather misleading name, and one more suitable for *E. acervula.* (For previous remarks on *E. fastigata*, see these Proceedings, 1902, p.588).

E crebra, usually known as Narrow-leaved Ironbark, and having a red timber, and very small fruits, is the common Ironbark of the felsitic-area around Yerranderie and Colong. Barrallier's entry of the 24th November, 1802, refers to the quartz-felsite country (which he called granite) between the South Peak and Alum Hill, near Colong, and is as follows:—"The trees there are the blue gum and ironbark, of medium height. The most abundant stones are the blue granite. The plants are similar to those in the environs of the Hawkesbury."

The blue gum and ironbark mentioned are *E. tereticornis* and *E. crebra* respectively; and the above is his last entry concerning ironbark, as, on the following day, he ascended to elevations above that at which this tree grows.

E. crebra occurs in Queensland, but after coming into New South Wales, on Northern New England, at altitudes up to 3,000 feet, the colder southern portion of the Main Divide causes it to spread south-westerly, to about Dubbo on the one hand, and down the East Coast on the other. It is common along the Goulburn River, a tributary of the Hunter, where the low portion of the Liverpool Range allows it easy access on to both the eastern and western watersheds. It appears to prefer soils rather acid than basic; and its presence would usually indicate that the rock upon which it was growing contained over 60% silica. At the same time, the Hawkesbury Sandstone appears to be generally too acid for the species. It will flourish on a fairly sandy soil right up to within a few yards of basalt containing only 45% silica, but producing an excellent soil, when it will cease abruptly. It may not be the amount of silica in the soil which regulates its distribution, but possibly its objection to the greater quantity of either ferrous oxide, magnesia or lime usually found in the more basic rocks, or it may prefer the potash, which is a constituent generally occurring in greater amount in the more acid formations. There are other ingredients which may have a regulating influence, especially soda, which occurs in varying quantities in both acid and basic rocks; and the whole question provides a most interesting subject for investigation. The presence of free silica affects the physical condition of the soil, and gives it capillary properties; consequently the physical characters may sometimes be more important than the chemical constituents. South of the latitude of Sydney, *E. crebra* is not usually found at elevations exceeding 2,000 feet, though, near Colong, some trees are growing at an altitude of about 2,500 feet. This is somewhat remarkable, as the locality is towards the southern limits of the species, which avoids the cold regions, as in fact do all the true Ironbark-group, and does not occur in either Victoria or Tasmania.

E. tereticornis, Forest Red Gum, was not seen beyond Colong, the elevation being too great. It prefers the quartz-felsite in this district, and usually shuns the more acid rocks. This is a species which avoids the colder parts of the Mountain-Area, and is also absent from Tasmania.

Leucopogon biflorus was found at Mount Werong, as a little, straggling, rather prickly shrub. It closely resembles *L. setiger*, and each commonly has two, small, pendulous flowers on axillary peduncles, the distinctive difference being that the peduncle of the former is very short, while that of the latter is usually about three lines long.

L. Fraseri occurs on the Silurian Slate beyond Bindook Swamp (2,800 feet), and on granite at Mount Werong (3,900 feet). It is a prostrate plant, somewhat resembling *L. virgatus*. *L. Fraseri* is recorded from Victoria, Tasmania, and New Zealand(B.Fl. vol.iv., p.218).

The absence was remarked of certain well-known Persoonias which are common on the Blue Mountains, nothing being noticed of *P. mollis or P. myrtilloides.*

Only one species of Grevillea, *G. laurifolia*, was noticed beyond Colong, and this had the same prostrate, rambling habit usually adopted by this plant on the Blue Mountains.

It occurs around Colong at an elevation of about 2,100 feet, and also near Mount Werong. The genus Grevillea is only sparsely represented in the coldest parts of Australia.

Bindook Swamp.—Ensign Barrallier discovered Bindook Swamp on the evening of 25th November, 1802, and, in his journal, made the following entry:—"From a short distance the swamp could be mistaken for a meadow, filled as it is with reeds, which prevents the water with which it is well provided, and which is very good, being seen. These reeds are similar to those growing inland in Europe."

The facies of this swampy land has been changed during the last sixty years, owing to the number of stock constantly browsing over it; but the most conspicuous plants which go to make up its flora, at present, are *Bæckea Gunniana* about 5-7 feet high, *Leptospermum lanigerum*, *Hakea microcarpa*, *Heleocharis sphacelata* (only a little left), and *Lepidosperma concavum*, a blady grass about four feet high.

It seems probable that the reeds referred to by Barrallier are *Heleocharis sphacelata*, as plants of this genus are widely spread over the world; but as most of the waterholes have become filled, only a few of these reeds now remain at Bindook, but in Colong Creek are plentiful in places.

Total Eucalypts.—Between Camden and Burragorang, a distance of about 22 miles, the total number of Eucalyptus species noticed by the roadside amounts to 22, of which only two occur in Tasmania, viz., *E. Sieberiana* and *E. Macarthuri*, the latter so far only known around Deloraine.

From the Wollondilly Bridge, past The Peaks towards Kowmung, in a distance of about 20 miles, 22 species were again noted (including the doubtfully identified *E. Wilkinsoniana*), nine of which are not mentioned in the first list, and three of the total being found in Tasmania, viz., *E. Sieberiana*, *E. amygdalina*, and *E. acervula.*

Between Colong and Mount Werong, a distance of about 25 miles, there were again 22 species noticed by the side of the bridle-track, of which 10 are not recorded in the previous two lists, making a total of 41 species of Eucalyptus between Camden and Mount Werong, a distance of about 70 miles. Of this third list, 7 are represented in Tasmania, viz., *E. coriacea*, *E. Sieberiana*, *E. amygdalina*, *E. obliqua*, *E. acervula*, *E. viminalis*, and *E. fastigata*, which is possibly a form of *E. regnans*.

Percentage of Tasmanian Plants.—As an evidence of the dominating influence of climate, it is instructive to note that, between Camden and Burragorang, with a range of elevation extending from 230 to 1,800 feet above sea-level, about 170 species of plants were recorded, 30 % of which occur in Tasmania.

From Burragorang to The Peaks and the Kowmung, with a range of elevation from 300 to 2,500 feet, about 230 species were noticed, 35 % of which are Tasmanian plants.

In the more distinctly mountain or colder climate, from Colong to Mount Werong, with altitudes ranging from 2,000 to 4,000 feet, out of about 170 recorded species, 48 % are represented in Tasmania.

As the time at my disposal was limited, when making these notes, it is certain that a proportion of the smaller plants especially, has been overlooked, and the lists cannot be regarded as complete. On the other hand, some of those now recorded are gradually being destroyed, owing to clearing operations, and, in the near future, will be unknown in the various localities.

I wish to express my thanks to Mr. J. H. Maiden, F.L.S., and Mr. E. Betche for assistance and corroboration in the identification of a number of the plants.

EXPLANATION OF PLATE XVIII.

The Peaks, Yerranderie (looking west from the Wollondilly River).

Postcript added January, 1912—A list of additional species collected during a second visit to the district, in December, 1911, will be given with the next paper of the series.

ON THE GENUS *DIPHLEBIA*, WITH DESCRIPTIONS OF NEW SPECIES, AND LIFE-HISTORIES.

By R. J. Tillyard, M.A., F.E.S.

(Plates xix.-xx.)

The genus *Diphlebia* forms one of a group of three closely allied genera united by de Selys to form the sixth legion (*Amphipteryx*) in his classification of the subfamily *Calopteryginæ*,* — *Devadatta* (*Tetraneura* of Selys), *Amphipteryx*, and *Diphlebia* (*Dineura* of Selys). These are from somewhat widely scattered regions, *Devadatta* occurring in the Malay Peninsula, Lower Siam, and Borneo; *Amphipteryx* in Colombia; and *Diphlebia* in Australia. The characters which distinguish the group from all other genera of the subfamily are the following—No antenodals continued into, or lying in, the subcostal space beyond the level of the arculus. Wings petioled to near level of arculus. Upper side of quadrilateral straight. Basilar space free. Cu_2 distinctly curved at its end. Superior appendages of male distinctly forcipate (de Selys "semi-circulaires").

The three genera may be clearly distinguished by the following table:—

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* Bull. Acad. Royale de Belgique, 1853, pp. 66-67; 1859, p. 16; 1869, p 18.

	Devadatta.	*Amphipteryx.*	*Diphlebia.*
Number of antenodals prolonged into subcostal space	4	3	2
Quadrilateral	3-celled	free	free
Nodus	one-third from wing-base	a little less than one-third from wing-base	a little less than one-half from wing-base
M_2 departing from M_1 ...	4-5 cells after nodus	4-5 cells after nodus	close up to nodus (de Selys "une cellule après le nodus").
Sectors interposed between M_4 and Cu_1	present	absent	present
Type	*Tetraneura argioïdes* de Selys	*Amphipteryx agroïdes* de Selys	*Amphipteryx* (*Dineura*) *lestoïdes* de Selys.

Each of these genera remained monotypic, until the discovery of *Diphlebia euphæoïdes* by me, in North Queensland. In the present paper, two more new species are described, bringing the total number up to four. Besides this, I have been enabled to study the life-history of one of these new species in detail, and have also collected a considerable amount of new information concerning the life-history of *D. lestoïdes* Selys, which fills in the gaps in my original paper on that species.[†] The facts thus gathered together, afford an opportunity of dealing with the whole genus in one paper, in which the new species may be described, keys given for the differentiation of the four known species, the life-histories of two species related more fully than was before possible, and the characteristics of the genus revised where found necessary.

Descriptions of New Species.—One of these was taken by Mr. F. P. Dodd at Kuranda, in December, 1907. His capture consisted of one mature and one somewhat younger male; the female is not known. The other was first taken by Mr. A. MacCulloch, of the Australian Museum, at Rocky Creek, near Caroda, N.S.W., in 1909. Later on, through the kindness of Mr. A. Mack, of Pallal Station, near Bingara, who invited me to make his home my headquarters for a collecting expedition, I was myself enabled to visit this locality, and to obtain a fine series of the insect, and to study its life-history on the spot.

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[*] "New Australian Species of the Family *Calopterygidæ*." These Proceedings, 1907, xxxii., p.394. The name *euphæoïdes* was suggested to me by M. René Martin.

[†] "Life-History of *Diphlebia lestoïdes* Selys." These Proceedings, 1909, xxxiv., pp.370-383.

DIPHLEBIA HYBRIDOIDES, n.sp. (Plate xx., figs. 5 and 9).

♂. *Total length* 52, *abdomen* 40, *hindwing* 33, greatest breadth 7 mm.

Wings: *neuration* black. A broad transverse dark brown band crossing all four wings, from midway between nodus to the beginning or middle of pterostigma. *Pterostigma* 3·3 mm., black. Six *antenodals* on all four wings; *postnodals* 26 on fore, 18-22 on hindwings. Head: blackish with two brown occipital spots; labium pale brownish. (The colouring is badly faded. In the live insect the spots are probably blue, and there may be other markings). Thorax: *prothorax* black, with two large spots, probably blue. *Meso-* and *metathorax* probably bright blue, with a black dorsal line, and, on each side, narrow antehumeral and lower lateral black stripes (as in all other known species of the genus). *Legs* blackish; measurements of foreleg:—femur 4 mm., tibia 5 mm., tarsus 1·7 mm. Abdomen slender, cylindrical; 1-6 tapering very slightly, 7-10 slightly enlarged again. Colour light blue (much faded except in one or two places), marked with black, as far as the pattern is discernible, as follows—1, a transverse basal bar; 2, a fine dorsal line and large cross-piece, one-fourth from apex of segment; 3, a fine dorsal line along basal third of segment; 3-6, two small slanting lines near apex; 5-6, two faint dots near base; 7-9, clear blue all over; 10, blue, probably shaded apically with brown or black. Appendages: *superior* 1·6 mm., forcipate, very slender, tapering to tips, black (or, possibly, blue in the living insect); a large inferior tooth or spine one-third from base; inner margin finely serrated near tips, outer margin with small dense hairs. Seen sideways, they are remarkably upcurved. *Inferior* 0·3 mm., thick, subtruncate, black, with an inner pointed projecting portion (Plate xx., figs. 5*a*, *b*).

A second male, evidently less mature, has the transverse banding on the wings very pale.

♀. Unknown.

Hab.—Kuranda, North Queensland.

Type ♂, and cotype ♂, in my collection, taken by Mr. F. P. Dodd(December, 1907).

This species can be distinguished, at once, from all other species of the genus by *the large inferior spine on the superior appendages*, also by the slenderness of the appendages towards the tips, and their upcurvedness when viewed sideways. In colouration, it resembles *D. lestoïdes*, but the shape of the abdomen is closer to that of *D. euphæoïdes*. The banding of the wings may also be considered as intermediate between the narrow milky band of *D. lestoïdes* and the deep, almost black, shading of *D. euphæoïdes*, which nearly covers the wing. For these reasons, I have proposed the name *D. hybridoïdes* for this species.

Owing to the excessive summer rains of the past few years in North Queensland, no further specimens of this interesting insect have been taken. But as the locality is now known, it is to be hoped that the unknown female and less faded males will soon be discovered.

Diphlebia nymphoides, n.sp. (Plate xx., figs. 4, 8).

♂. *Total length* 50, *abdomen* 35, *hindwing* 31, greatest breadth 6 mm.

Wings: *neuration* dark brown, the whole wing suffused with a transparent brownish tint. *Subcostal space* very narrow, the subcostal and radio-median nervures *practically fused up to arculus*; *pterostigma* 4 mm., black. Six to seven antenodals and 25-30 postnodals on all four wings. Head: *eyes* black; *vertex* black, hairy; *front, labrum,* and *labium* black. Thorax: *prothorax* velvety black; conspicuous basal and apical collars of bright blue, also two large oval spots of the same colour. *Meso-* and *metathorax* brilliant blue, with dorsal band and collar of jet black; on each side a straight black antehumeral stripe and a lower lateral black stripe, both narrow; underside tinged with grey and pink; wing-bases with large blue spots; notum black spotted with blue. *Legs* black, underside of femora pinkish. Measurements of femur, tibia and tarsus respectively are—foreleg, 4-4·5-1·7 mm.; middle leg 5-5·5-2 mm.; hind leg 7-5·5-2 mm. **Abdomen** slender, subcylindrical, 1-3 slightly enlarged, 4-10 quite cylindrical. Colour brilliant blue, marked with jet black as follows—1, a transverse basal band; 2, a narrow transverse basal band, a fine dorsal line crossed about one-third from apex of segment by a short crosspiece; 3, a fine dorsal line spreading apically into a large diamond-shaped patch; 4-7, a thick convexly curved dorsal band spreading so as to cover the whole of the apical fourth of the segment; 8, a narrower and straighter dorsal band, spreading as in 4-7; 9, a large semicircular basal patch, from which projects a sharp dorsal spike; 10, black with two large oval blue spots. **Appendages:** *superior* 2 mm., forcipate, black, rough and spiny, narrowed about the middle; tips rather broadened and rounded; seen sideways, the tips are enlarged downwards. *Inferior* 0·5 mm., black, close together, well-rounded and almost touching at tips; seen sideways, they appear truncated(Plate xx., figs.4*a*, *b*).

♀. *Total length* 47, *abdomen* 33, *hindwing* 33, greatest breadth 6 mm.

Wings: *pterostigma* 3·5 mm., cream-coloured between black nervures; *subcostal space* paler and wider than in male, with the subcostal and radio-median nervures quite distinct from bases onwards. **Head**: *eyes* brown bordered inwards with cream-colour; *vertex* hairy, blackish, with four brown spots, the front pair rather small and rounded, the back pair larger, elongate irregular subtriangular(Plate xix., fig.11); *front* brown, hairy; *clypeus* brownish edged with black; *labrum* very pale brown bordered with black, and with a fine short central black line; *labium* pale dirty brownish; *mouth* black. **Thorax**: *prothorax* and upper part of *thorax* as in male, but with the blue colour replaced by dark brown; *sides* pale greyish touched with fawn-colour, with a narrow lateral black band; *notum* dark brown with paler spots. *Legs*: coxæ and undersides of femora whitish; femora pale brown darkening to blackish; rest dull blackish. **Abdomen** subcylindrical, 1-3 slightly enlarged, 4-7 somewhat tapering, 8-10 slightly enlarged again. Colour brown; 1, whitish on sides; 2-3, a medium brown with black sutures, a fine black dorsal line crossed at one-fourth from apex by a flattened triangular or diamond-shaped mark; 4-7, like 3, but much darker, dorsal line thicker and apical mark less regular; sutures black, wider on sides, a long black bar low down on each side of 4-6, a short bar on 7; 8, dark brown, paler on sides; 9, almost black basally, touched with brown apically and on sides; 10 very pale brownish, with black dorsal line. Appendages 1 mm., blackish, conical, sharply pointed.

Hab.—Rocky Creek, near Caroda; Nandewar Ranges, N.S.W.; also (less commonly) Pallal Creek, near Bingara, N.S.W.(December, 1910).

Types: ♂♀, and series of cotypes in my collection, taken by myself, in above localities.

The two localities given are only a few miles apart, and both are tributaries of the Horton River, which joins the Gwydir near Bingara. The insect frequents only the rocky parts of the creeks, and is absent from the lower part of Pallal Creek, and from the Horton River itself. It is one of the most beautiful and brilliant insects known to me, the blue of its body far outrivalling the colour of *D. lestoïdes*, itself a brilliant insect. I have therefore chosen the name *nymphoïdes* (Greek νύμφη, a bride) in allusion to its beauty.

Comparison of the Four Known Species.

The four known species, *D. lestoïdes* Selys, *D. euphæoïdes* Tillyard, *D. hybridoïdes*, n.sp., and *D. nymphoïdes*, n.sp., are all closely allied, and form a homogeneous and natural Australian genus. The following table gives the most important differences for the males :—

	D. lestoïdes ♂	*D. euphæoïdes* ♂	*D. hybridoïdes* ♂.	*D nymphoïdes* ♂.
Wings:	narrow milky band (sometimes absent)	opaque black shading nearly covering wing	broad brown band towards apex	transparent light brown tint all over
Abdomen:	1-2 hairy	1-2 not hairy	1-2 not hairy	1-2 not hairy
Shape:	cylindrical, rather broad and flattish	narrow and rounded	narrow and rounded, longer than *D. euphæoïdes*	medium width, fairly rounded, cylindrical
Colour:	bright blue, with very little black	1-3 and 8-9 only, bright blue; rest jet black	bright blue, with very little black	brilliant blue with broad and conspicuous black pattern

[For comparison of abdomen, see Plate xx., figs.6-9; two varieties of the very variable *D. lestoïdes* are given, 6*a* from Snowy River, Jindabyne; 6*b* from Heathcote, Illawarra, N.S.W.].

Superior Appendages:	thick, flattish, of equal width all along, pale blue (fading to black in dead insect)	narrow in middle, tips rounded; black	smaller, much thinner towards tips, black; large spine underneath	most like *D. euphæoïdes*, narrow in middle, tips rounded, black (inferior appendages shorter and smaller than in *D. euphæoïdes*.)

[For comparison of male appendages, see Plate xx., figs. 2-5. These appendages are very thick and of rough surface, being covered all over with tiny spines and other irregularities; hence they are exceedingly difficult to represent by a camera-lucida drawing. In determining a species, therefore, by means of these appendages, one must be prepared for individuals of the same species showing minor differences, which may be due either to the individual itself, or more probably to the particular angle from which the appendages are drawn, the outline of the thick inferior appendages especially changing rapidly with the angle of vision.]

To separate the three known females (that of *D. hybridoïdes* being so far undiscovered) is a more difficult task. The prothoracic differences seem scarcely sufficient to rely upon, and the same may be said of the structure of the occiput. The male appendages being very similar in plan, we might reasonably infer this to be the case with the occiput and prothorax of the females. The best criteria seem to me to be—(1) the epicranial pattern; (2) the measurements of the tibia of the fore-leg; (3) the comparative length, and breadth of the wings; (4) the shape of the abdomen.

(1). The epicranial colouration is a brown pattern on a black ground. This pattern may be divided into two parts *a*, the vertical spots, of which there are two, lying between the antenna-base and the basal ocellus on each side of the main longitudinal axis; *b*, the postocellar or occipital band, lying close to the occipital ridge between the eyes.

In *D. lestoïdes* ♀, and *D. nymphoïdes* ♀, the vertical spots are very distinct and rounded, but those of *D. lestoïdes* have a tendency to a subtriangular shape. In *D. euphæoïdes* ♀, however, the spots are enlarged into elongated, subtriangular patches which are joined by a stalk to the brown edging of the eyes.

In *D. lestoïdes* ♀ and *D. euphæoïdes* ♀ the occipital band is regular, rounded and slightly enlarged at each end, and with a tendency in *D. euphæoïdes* ♀ to carry a small central spike pointing forward. In *D. nymphoïdes* ♀ the occipital band is broken and divided into two very irregular, subtriangular patches, notched about the middle forwards (see Plate xix., figs. 9-11).

These epicranial patterns are, of course, subject to slight individual variation, but are sufficiently constant to be relied upon.

(2). *D. lestoïdes* ♀ can be recognised at once by the great length of its fore-legs. The measurements for the tibiæ are—*D. lestoïdes* ♀ 7; *D. euphæoïdes* ♀ 4·5; *D. nymphoïdes* ♀ 5 mm.

(3). The measurements for the hindwing are—*D. lestoïdes* ♀ 34-35 long, greatest breadth 6; *D. euphæoïdes* ♀ 32 by 6; *D. nymphoïdes* 32 by 6·2 mm.

(4). In comparing the abdomens of the three females, that of *D. lestoïdes* is seen to be very cylindrical, somewhat flattened, and much broader than either of the others; that of *D. euphæoïdes* is distinctly narrow and rounded; while that of *D. nymphoïdes* is of intermediate breadth and roundness.

Besides these differences, it may be remarked that the pterostigma of *D. euphæoïdes* is narrower and slightly shorter than those of the other two. In the whole of my series of *D. nymphoïdes* ♀, the pterostigmas are uniformly pale cream-colour between black nervures; those of *D. lestoïdes* ♀ are usually so, and those of *D. euphæoïdes* much darker. These differences, however, cannot be pressed, as we do not know what changes may take place in the colouration as the insects become more and more mature.

Life-Histories of D. lestoïdes Selys., *and D. nymphoïdes*, n.sp.

In my former paper on the life-history of *D. lestoïdes*,* I was compelled to leave some unavoidable gaps in the record, as I had been unable to find the full-fed nymph, and could only surmise what its habits might be. The beds of the mountain-creeks of the Rodriguez Pass and other parts of the Blue Mountains, and also the Heathcote Creek and Woronora River in the Illawarra district, (the places where I studied this species) are remarkable in consisting almost entirely of solid bed-rock. The detached rocks and boulders are mostly of great size, and quite immovable. There were none of the flat or rounded rocks of medium size that so often occur in rapid streams. I made it my object to search for these latter, in the hope that, by turning one of them over, I might find the larva clinging to the underside. During two visits to Heathcote with a friend, our united efforts succeeded in overturning several large boulders, but without any sign of the larva; if it were there, it either got washed off in the swirl of water, or succeeded in escaping before we overturned the rock. However, fortune at last came my way. While dredging with a flat, triangular net along the smooth rock-bottom of the creek at Medlow, Blue Mountains, just above the lake, on November 13th, 1909, I dislodged a small flat slab of rock into my net. On the underside of this I found a well-grown larva of *D. lestoïdes* This is the only larva of this species that I have ever found. A figure of it is given in Plate xix., fig.1. I kept this in a small jar until the beginning of January, 1910. It fed well, and usually sat still at the base of a stick. It showed very little activity, and its huge caudal gills seemed to be very cumbersome, and much in the way when it was moving. About the beginning of December it changed its skin. When it appeared to be full-fed, I killed it with chloroform, carefully extracted the gizzard, and mounted it in alcohol. A description of this larva is given below.

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* These Proceedings, 1909, xxxiv., p.370.

On December 14th, 1910, during my collecting trip to the north-west of New South Wales, I visited Rocky Creek, near Caroda, on the edge of the Nandewar Ranges. This is a splendid collecting ground, and I found the beautiful *D. nymphoïdes*, n.sp., in sufficient numbers to lead me to hope that I might obtain the larva. At the point where I struck the creek, just above some big falls, the bed consisted of solid basaltic rock, with huge vertical-sided boulders standing up in many places. I carefully searched the sides and crevices of these rocks, and obtained two cast-skins, but no living nymphs Further up, the character of the creek changed, and I found a long stretch of clear water rippling over small rocks and pebbles. Here the creek was overhung with green trees and bushes. In such a setting, this glorious new *Diphlebia*, resting on rocks, skimming the surface of the water, or perching, several in a row, along the outstretched, bare branches of shrubs, made a picture that I shall never forget. On one horizontal bough, I counted no less than seven brilliantly-coloured males, perched about a foot apart, and all sitting in exactly the same attitude, with wings outspread horizontally, body held straight out, also horizontally, and at an angle of about 60° to the bough.

In this part of the creek, the rocks were easily lifted and overturned. At the very first try, I found two full-fed larvæ under a fair-sized rock. The next dozen rocks or so yielded nothing, and then, on a smaller rock, I found a peculiar *Aeschnid* larva that seemed to be *Caliæschna conspersa*. Somewhat higher up the creek, under some rocks only half-covered by water, I took three more *Diphlebia*-larvæ. Having examined some fifty or sixty rocks during the afternoon, I finished up with seventeen *Diphlebia* larvæ, all nearly full fed, and four *Aeschnid* larvæ. Besides these, I found two female *Diphlebia* emerging, and observed no less than three of them ovipositing under the water, just in the same way as I have already described for the female of *D. lestoïdes*. The eggs were found in the tissues of the water-weed, and were of the same size and shape as those of *D. lestoïdes* already described. I also spent some time looking for young larvæ, and found over a dozen, from about 2 to 6 mm. in length, on various rocks. Some of these young larvæ were on the same rocks as the full-fed larvæ, and I think it is quite likely that the earliest-hatched of the new brood fall victims in large numbers to the rapacity of the later members of the old brood.

The young larvæ were of a pale semitransparent whitish colour, with narrow gills; in appearance, almost exactly like the young larva of *D. lestoïdes* figured in my former paper (*q.v.* p.376 and fig.4). They were fairly active, running away and hiding in small crevices and depressions in the rocks. Unfortunately it was impossible to keep any of these alive during the long rough journey back to Sydney, so that I was unable to follow up the changes through the different stages of growth. By the time the larva has grown to a considerable size, the colour has become a dark shining greyish-black. I was particularly struck with the helplessness of the larger larvæ as soon as they were lifted out of the water. Their huge, cumbersome, caudal gills made it almost impossible for them to get along, for they stuck to the wet rock, so that the larvæ could only crawl slowly and helplessly along, trying always, like an iguana, to get on the side of the rock away from me. I tried several times to see how they behaved under water. To do this, I took a rock to which a larva was clinging, and lowered it gently into the water, watching the larva carefully. I found that, under water, they could move with more rapidity, but I was easily able to follow them with my hand, and catch them again merely by feeling for them. Occasionally one got detached from a stone, when it would spread out its legs and caudal gills, and rock itself slowly to and fro, gradually sinking the while. These observations satisfied me that the larva was purely a *rock-liver*, and that, once detached from its refuge, it was a hopelessly clumsy creature. As was evident from the form of the legs and abdomen even in the exuviæ, the whole insect is built so as to be able to cling flatly and closely to the rock-surface, where it is able to lie concealed, and capture its prey in the running water.

The emergence of *D. nymphoïdes* is very similar to that of *Austrogomphus heteroclitus*, a species which was emerging in great numbers on the same creek. Both larvæ climb up the rocks, just above water-level, and emerge there, only the *Diphlebia* prefers the vertical or overhanging surfaces, facing down-stream, so as to be away from the current; while the *Austrogomphus* usually chooses a more slanting surface, often on the up-stream side, so that it gets washed by the little wavelets and ripples, and is thus apparently helped upwards along the rock The newly emerged insects, in both cases, rest only just out of reach of the water, and fly straight off into the bush as soon as their wings are dry enough.

Three of the larvæ which I took, emerged during the following week. They were placed in wide-mouthed bottles half-filled with water, and with sticks to climb up Two of them emerged with the exuviæ partly under the water; the third climbed about two inches above the water. All three were females. This leads me to believe that the males emerge considerably earlier, on the whole, than the females; and certainly their colouration, at the date of my visit, suggested that they were the more mature.

Having thus filled in the gaps in our knowledge in the life-histories of two species of this interesting genus, it remains to give descriptions of the full-fed larvæ, and to indicate their specific differences.

Description of Nymph of Diphlebia lestoïdes (Plate xix., fig.1).

Total length 33 mm.

Colour dark brown, somewhat paler on legs; head and caudal gills almost black. Head 4·5 long by 5·6 mm. wide. *Eyes* black, rounded, widely separated; postocular lobes well rounded, slightly rough; just in front and below each eye is a series of six or seven sharp spines, which can be seen projecting from under the front border of the eye. *Frontal shelf* 1·3 long by 3 mm. wide, prominent. The huge *labium*, already fully described in my former paper (p. 378, and fig. 2), projects beyond and on each side of the front. *Antennæ* (fig. 5 of former paper) long and slender, 5·7 mm. in the specimen under description. *Ocelli* pale whitish, quite conspicuous. Thorax: *prothorax*, 1·5 long by 4·5 mm. wide, well developed, lateral lobes spiny, not angulated, their shape being rather bluntly sub-triangular, with the tip rounded off. *Meso-* and *metathorax* 5 mm. wide; *wing-cases* 7 mm. long; hind wing-case 1·2 mm. wide; reaching to end of fifth abdominal segment. Legs: *femora* flat and rather broad, smooth, those of fore and middle legs resting in a horizontal plane, but those of the hind-legs raised into a nearly vertical plane; measurement, fore 5·5, middle 6, hind 9 mm. *Tibiæ* narrow, rounded, smooth; about 6 mm. long on all legs; *tarsi* short, fore 1·8, middle 2·6, hind 3·2 mm. Abdomen rather short, 12 mm.; 4 mm. wide at base, tapering to 2 mm. at segment 10. Each segment has a finely pitted, dorsal surface, but appears rather smooth and shiny; colour dark brown with no pattern. Caudal Gills: *median* 10·5, *laterals* 11·5 mm., each. The laterals lie in one plane pressing against the rock, but the median gill is held at a slight slant above them; when crawling, however, the median gill is often depressed so as to be almost level with the other two. *All three gills are* *strongly triquetral*, the laterals being about 2·5 mm. broad at their greatest breadth, the median slightly narrower. The last 3 mm. of each gill consist of an attenuated tail, carrying some long irregular hairs. Colour a very dark brown. (Plate xix., fig. 3).

Hab.—Medlow, Blue Mountains, N.S.W. A unique specimen, taken November 13th, 1909.

Larval Type: the above unique specimen is in my collection.

Description of Nymph of Diphlebia nymphoïdes. (Plate xix., fig. 2).

This nymph is so similar in general appearance to that of *D. lestoïdes*, that it is only necessary to give the chief measurements, and to indicate the specific differences. The general colour is blackish above, dull-greyish beneath. This is of interest, as the basaltic rocks at Rocky Creek are grey or blackish, while the sandstone of the Medlow Creek is brown. Thus the colour of the larva approximates closely to that of the rock it inhabits. The nymph is slightly smaller than that of *D. lestoïdes;* total length 30-32 mm. *Head* somewhat narrower, about 5 mm. wide. *Antennæ* 5 mm., basal joint and base of second joint spiny; basal half of second joints and bases and tips of joints 2-5 white, not black (Plate xix., fig. 7). *Thorax* and *abdomen* very similar to those of *D. lestoïdes*. *Caudal gills* slightly narrower; laterals 10 mm., median 9 mm., with tails only 2 mm. long; shorter, thicker, and hairier than in *D. lestoïdes*. *Fore-legs much smaller than in D. lestoïdes*, the femur being 4 mm., and the tibia scarcely 5 mm. long. Upper surface of head and thorax strongly pitted all over; abdomen slightly less pitted.

A comparison of the tibia of the two species shews some small differences. In *D. nymphoïdes* (Plate xix., fig. 4) the lateral lobes are not quite so long as in *D. lestoïdes* (my former paper, fig. 2); and the innermost of the four teeth is not pointed, but somewhat blunt and nodding; the spines or thick short hairs on the outer border are less regular; and the median lobe of the mentum is less indented and a little less prominent.

Hab.—Rocky Creek, Caroda, N.S.W. Taken December 14th, 1910.

Larval Type and co-types in my collection.

The Structure of the Larval Gizzard.

I have examined the gizzard of the larvæ of both species, and, as might be expected, there is very little difference. The dentition is arranged in sixteen fields or folds, eight of these being "major" folds and eight "minor." The gizzard of *D. lestoïdes* shews considerably greater regularity in the number of teeth on a fold than does that of *D. nymphoïdes*. Each fold is of considerable length, about 1 mm. in actual size, so that, in a "minor" fold, the teeth lie in a single longitudinal line, while, in a "major" fold, the teeth (a greater number) lie also in a longitudinal line, with a tendency to forming *two* lines at the upper end. In the gizzard of *D. lestoïdes*, the major folds each contained 11-12 teeth, the minor 8-9. In that of *D. nymphoïdes*, the major folds contained from 11-14; and the minor from 4-7, with one minor fold containing 8 teeth, and one very tiny extra tooth. Representing these tiny extra teeth by ½, the teeth in this gizzard, taking the folds in order, were 7, 11, 8½, 12, 7, 13, 6, 11, 5, 11, 4, 14½, 5, 13, 4, 11. In *D. lestoïdes*, I noticed several isolated teeth lying low down outside the main folds; as many as three of these lay between two consecutive folds (see figure). In *D. nymphoïdes*, I found only one isolated tooth in the whole gizzard.

By comparing the figures given of one-half of each of the above gizzards, the greater irregularity of that of *D. nymphoïdes* is very evident. I should not like, however, to suggest that this difference is specifically constant, as I have examined only one gizzard of each species. Bearing in mind the extraordinary difference in the number of teeth in the two gizzards of *Petalura gigantea* Leach, described by me in a former paper, we should be content, I think, to regard variations in the actual number of teeth on a fold as purely individualistic.

The type of longitudinal fold exhibited in these gizzards is, I believe, found in other *Calopterygid* larvæ whose gizzards have been examined. A somewhat similar longitudinal arrangement exists in the *Gomphine* larvæ; but, in these, there are only four folds, each containing a great many teeth, and shewing as many as three or four abreast on the upper portions. In the *Anisoptera*, it is certainly true that the larval gizzards determine the separation of the main groups, there being so far four main types known, viz., the *Libellulid* (*Libellulino-Corduline*), *Æschnine*, *Gomphine*, and *Petalurine*. If these are really four coördinate groups (a position which, I believe, could be easily maintained, and strengthened by many cogent arguments), we should seek to apply the same test to our admittedly unsatisfactory *Zygopterous* classification. I should like, therefore, to put it upon record now, though the elaboration of the facts must be left to later papers, that I have found the *Diphlebia*-form of gizzard to exist also in *Argiolestes* and *Isosticta* amongst the *Agrionidæ*, though the gizzards of the legions *Agrion* and *Lestes* of de Selys are absolutely different. These facts suggest that the present *Agrionidæ* are a collection of strongly *asthenogenetic forms descended along several main lines from more abundantly nervured insects*, of which the present-day *Calopterygidæ* may represent, fairly closely, various stages of descent. In this manner, we can trace, from a common ancestor, in descending asthenogenetric order, the single group-line *Diphlebia—Argiolestes—Isosticta*, though we cannot perhaps regard any single one of these three genera as lying in the *direct* line of descent of the group; that direct line having most probably been lost. It may be added that the main structure and habits of the larvæ of these three genera, their caudal gills and their labia in particular, agree with this view. We thus get a beginning of an insight into a natural scheme of classification for the *Zygoptera*, by means of which we may at last hope to separate fairly accurately, into coordinate groups, that great mass of asthenogenetic forms whose wing-venation has converged so remarkably, from widely different ancestral types, to one single petiolate wing-form.

In making the above statement, I am aware that I am traversing the received opinions of many profound students of the *Odonata*. If the above natural scheme be carried out, it can scarcely fail to indicate forms such as *Hemiphlebia*, *Selysioneura*, and a mass of genera in the legion *Protoneura*, not as highly archaic remnants, but as strongly specialised asthenogenetic or reduction-forms, many of which must be regarded as the most advanced *Zygopterid* types ever formed. A careful study of *Hemiphlebia* will, I believe, reveal that this is actually the case, and that the loss of the basal cross-vein in the quadrilateral of the fore-wing is the last and most advanced reduction-stage ever reached by any *Zygopterous* dragonfly; instead of being, as has been heretofore maintained, a remnant of an exceedingly archaic formation. It is time now, at any rate, that students of *Odonata* should refuse to be content with wing-venational studies only—though these must always play a most prominent part in all satisfactory schemes of classification—and that the evidence afforded by life-history studies, larval gizzards, and labia should be more carefully sought after, so that our knowledge of the *Odonata* may be made more complete and satisfactory.

Returning to the genus *Diphlebia*, it may be remarked that, though we must regard all *Calopterygidæ* as more or less archaic in some degree, there is strong evidence that *Diphlebia* is one of the most advanced types in the family. It has evidently progressed far along the zygoterous line of advance, the amount of reduction of the præ-nodal area being very great for a *Calopterygid*. Of the six remaining antenodals, *two only* are continuous across the subcostal space. I think, too, that the practical fusion of the subcubital and radio-median nervures in the wing of *D. nymphoïdes* ♂ is a strong proof of specialisation being successful in this genus. Who knows but that, in some far remote past age, an ancestor of the whole of the present *Odonata* brought about the fusing of the radius and median nervures in the same manner! One may wonder even that a petiolate wing with only four main basal nervures, subcubitus + radius + median forming an exceedingly strong second nervure, has not taken its place amongst the more highly specialised and successful zygopterous types of the present day.

Revision of the Generic Definition.

The characters of the genus, as defined by de Selys, need some slight modification, in order to include the four closely allied species now known. De Selys states, for instance, that in *Diphlebia*, there are sectors interposed between M_4 and Cu_1. I find this to be the case only in a few of my specimens of *D. lestoïdes*, and then usually in the hind-wing. The divergence of M_4 and Cu_1 towards the margin of the wing results in an increase of the number of cell-rows from one to two, and finally to three or four at the wing-margin (Plate xx., fig. 1), but the borders of the rows are not usually straightened out into a true sector, but remain in the less specialised condition shewn in the figure. This generic character, therefore, needs revision. Another point is the position of departure of M_2 from M_1. In most of my series, of all four species, M_2 continues in an almost unbroken curve from the nodus itself, though in some specimens there is a distinct, but not very sharp, break at the join. A third point is that de Selys describes the male superior appendages as "semi-circulaires, simples." This could hardly include the peculiarly shaped appendages of *D. hybridoïdes* with their large inferior spine. Again, de Selys says that the nodus in *Diphlebia* is placed a little less than one-half the wing-distance from the base of the wing. Taking *D. nymphoïdes*, the nodus is only

13 mm. from the base, whereas the total length is 31 mm., which seems to me rather too much for the "little, less," though that is only a personal opinion.

Further points of great importance, which differentiate this genus from *Devadatta* and all other *Calopterygine* genera, and shew it to be a close approximation to *Lestes*, are the absolute elimination of all cross-nervures in (*a*) the postcostal space above the petiolate anal vein, and (*b*) the whole space lying below R, from the arculus to the nodus. [In this connection it is also interesting to note that the position of the oblique vein is very variable in this genus. It is usually the *third* cross-vein from the join of M_1 with M_3 (see figure), but is not infrequently the *fifth*, and sometimes the *fourth*.] This line of specialisation, if continued until all but the first two antenodals were eliminated, the quadrilateral depressed and narrowed, and the distance between the arculus and nodus considerably lessened, would give us a close approach to a true *Lestine* wing.

The generic characters, amended on the above lines, will now be as follows—Two antenodals only, *viz.*, the one before and the one above the arculus, continued into the subcostal space. Quadrilateral, basilar space, postcostal space as far as the petiolation of the wing, and the whole of the space below the radius from the arculus to the nodus, free. Nodus lying at a distance *less than one-half but greater than one-third* of the whole wing-length, from the wing-base. M_2 departing from M_1 *under or very* close to the nodus. M_4 and Cu_1 diverging from one another slightly as they proceed to the wing-margin; a single row of cells at first between them, increasing to three or more rows, with or without distinct sectors. Superior appendages of male forcipate. Colour of male bright blue, with more or less black markings. Wings either clear or more or less barred or shaded.

Type, *Diphlebia lestoïdes*, Selys.

EXPLANATION OF PLATES XIX.-XX.

Plate xix.

Fig. 1.—Nymph of *Diphlebia lestoides* Selys (× 1⅔).

Fig. 2.—Nymph of *Diphlebia nymphoïdes*, n.sp. (× 1¾).

Fig. 3.—Caudal gills of nymph of *D. lestoides* Selys (× 3¼).

Fig. 4.—Left lateral lobe and part of mentum of labium of nymph of *D. nymphoides*, n.sp. (× 12).

Fig. 5.—One-half of larval gizzard of *D. lestoides* Selys (× 30).

Fig. 6.—One-half of larval gizzard of *D. nymphoides*, n.sp. (× 30).

Fig. 7.—Antenna of nymph of *D. nymphoides*, n.sp. (× 9).

Fig. 8.—Set of spines under front border of eye in nymph of *D. nymphoides*, n.sp. (× 7).

Fig. 9.—Head of *D. lestoides* ♀, Selys, imago, to shew epicranial pattern (× 4½).

Fig. 10.—Head of *D. euphœoides* ♀, Tillyard, imago, to shew epicranial pattern (× 4½).

Fig. 11.—*D. nymphoides* ♀, n.sp., imago, to shew epicranial pattern (× 4½).

[N.B.—Figs. 9-11 are only intended to shew the *epicranial pattern*, and should not be taken as accurate in other details.]

Plate xx.

Fig. 1.—Basal half of fore-wing of *Diphlebia nymphoides*, n.sp., ♂ (× 5).

Fig. 2.—Appendages of *D. lestoïdes* Selys ♂; *a*, dorsal; *b*, profile-view (× 10).

Fig. 3.—Appendages of *D. euphœoides* Tillyard ♂; *a*, dorsal, *b*, profile-view (× 10).

Fig. 4.—Appendages of *D nymphoides*, n.sp., ♂; *a*, dorsal, *b*, profile-view (× 10).

Fig. 5.—Appendages of *D. hybridoïdes*, n.sp., ♂; *a*, dorsal, *b*, profile-view (× 10).

Fig. 6.—Colour-pattern of abdomen of *D. lestoides* ♂; *a*, an individual from Jindabyne, N.S.W.; *b*, an individual from Heathcote, Illawarra, N.S.W. (× 2).

Fig. 7.—Colour-pattern of abdomen of *D. euphœoides* ♂ (× 2).

Fig. 8.—Colour-pattern of abdomen of *D. nymphoïdes* ♂ (× 2).

Fig. 9.—Colour-pattern of abdomen of *D. hybridoides* ♂ (× 2).

[N.B.—Figs. 6-9 represent a jet-black pattern on a brilliant blue ground.]

ORDINARY MONTHLY MEETING.

October 25th, 1911.

Mr. W. W. Froggatt, F.L.S., President, in the Chair.

The President announced that the Council was prepared to receive applications for three Linnean Macleay Fellowships, tenable for one year from April 1st, 1912, from qualified Candidates. Applications should be in the hands of the Secretary on or before 30th November, 1911, who will afford all necessary information to intending Candidates.

The Donations and Exchanges received since the previous Monthly Meeting (27th September, 1911), amounting to 14 Vols., 68 Parts or Nos., 6 Bulletins, 2 Reports, and 9 Pamphlets, received from 51 Societies, &c., and two Individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. David G. Stead exhibited a living male and a female example of the Oyster Blenny, *Petroscirtes anolius* (Cuv. et Val.) originally from Broken Bay, which he had kept alive (among others) for the past twelve months in a small saltwater aquarium. This interesting fish is found in and about oyster-shells along the coast of New South Wales, among which they spend their lives. Their eggs are deposited in the shells, and are closely watched over by the parents, the male being very bellicose. The mature male (alive) has the curious Cassowary-like helmet on the head. This has been described as a specific character, but it is purely sexual. Immature males, like the females, do not possess this character. Mr. Stead also drew attention to the mode of progression, showing that they moved in a normal manner forward. Mr. J. D. Ogilby had mentioned (Proc. Roy. Soc. Queensland, xxiii., p.54, 1911) that these fishes "never willingly moved forward in the usual manner of the class, but invariably retrograde." Mr.

Stead had found that though they very frequently retrograded, they quite commonly move forward, as did those exhibited. Several oyster-shells, showing a deposit of spawn of this species, were also shown.

Mr. A. McCulloch exhibited, by permission of the Curator of the Australian Museum, six Queensland fishes which appear to be new records for Australia.—*Callyodon pyrrhostethus* Richardson, from Dunk Island, near Cairns: *Scarichthys auritus* Kuhl & Van Hasselt, *Stethojulis kalosoma* Bleeker, *Balistes chrysopterus* Bloch & Schneider, and *Tetraodon nigropunctatus* Bloch & Schneider, from Murray Island, Torres Strait; *Zonogobius semidoliatus* Cuv. & Val., from Dunk Island, and Masthead Island off Port Curtis.

Mr. Whitelegge showed fresh specimens of *Utricularia flexuosa* Vahl, the submerged leaves interspersed with utricles, from Wooli Creek, Cook's River; the beautiful retiform alga, *Hydrodictyon utriculatum* Roth, from the Ascot Racecourse; and an uncommon Hepatic, *Anthoceros gracilis*, from Vaucluse.

Mr. E Cheel exhibited a number of interesting fungi, including —HELVELLACEÆ: *Morchella esculenta* Dill., Botanic Gardens, Sydney (E. Bennett; October, 1911)—PEZIZACEÆ: *Peziza vesiculosa* Bull., Zoological Gardens, Moore Park (A. S. Le Souëf; September, 1911)—MOLLISIACEÆ: *Pseudopeziza trifolii* Fckl.; on leaves of *Trifolium pratense* Linn.; Ohakune, New Zealand; and Franklin, Tasmania (E. Cheel). *P. medicaginis* Sacc.; on leaves of *Medicago sativa*; Penshurst (E. Cheel; June, 1911)—DOTHIDIACEÆ: *Phyllachora graminis* Pers.; on leaves of *Sporobolus Lindleyi* Benth.; Inglewood, Queensland (J. L. Boorman): and on *Zoysia pungens* Willd.; Narrabeen (E. Cheel); Centennial Park (A. A. Hamilton)—USTILAGINACEÆ: *Sorosporium cryptum* McAlp.; on inflorescence of *Panicum effusum* R.Br.; Cooma (W. Bäuerlen); Menah *viâ* Mudgee (G. Campbell). *Ustilago bromivora* F.v.M.; on Prairie-grass, *Bromus unioloides* H. B. & K.: Mudgee (J. D. Cox); Lismore (Manager of Wollongbar Experiment Farm); Cook's River (A. A. Hamilton); Hawkesbury College, Richmond (W. M. Carne)—PUCCINIACEÆ: *Aecidium soleniiforme* Berk.; on

[Printed off 6th February, 1912.]

leaves of *Oxylobium trilobatum* F.v.M.; Katoomba (J. H. Camfield). *Aec. eburneum* McAlp.; on pods of *Bossiaea heterophylla* Vent.; Kogarah(J. H. Camfield); and on *B. microphylla* Sm.; Torrington, N.S.W.(J. L. Boorman). *Uromyces thelymitræ* McAlp.; on leaves of *Thelymitra nuda* R.Br.; Castle Hill, near Parramatta(A. A. Hamilton; October, 1911). *U. trifolii* Wint.; on leaves and petioles of *Trifolium glomeratum* Linn.; Penshurst(E. Cheel; July-October, 1911). *Puccinia saccardoi* Ludw.; æcidiospore-stage, on leaves of *Goodenia bellidifolia* Sm.; Leura(A. A. Hamilton; December, 1910). *P. burchardiæ* Sacc.; on stems of *Burchardia umbellata* R.Br.; Cheltenham(A. A. Hamilton; September, 1911)—NIDULARIACEÆ: *Sphærobolus stellatus* Tode; on dead wood; Botanic Gardens(E. Bennett; January, 1911)—TULOSTOMACEÆ: *Battarrea phalloides* Dicks.; Cobar(L. Abrahams; September, 1911)—PHALLOIDEÆ: *Anthurus aseroëformis* Lloyd; Mount Royal Range, Scone(W. V. Haynes; April, 1910)—DEMATIACEÆ: *Helminthosporium Ravenelli* Curt.; on inflorescence of *Sporobolus indicus* R.Br.; Hawkesbury College, Richmond(W. M. Carne; March, 1911); Penshurst(E. Cheel; March, 1911)—Specimens of fresh peach-twigs were also exhibited, showing sucker-branches which had been allowed to spring up below the graft or bud, very badly infested with the "Peach Leaf Curl"(*Exoascus deformans* Fckl.), whilst the branches or twigs of the "Muir" itself showed no signs of the disease.

Mr. Maiden sent, for exhibition, specimens in formalin, and a coloured drawing of the curious, diminutive saprophyte, *Thismia Rodwayi* F.v.M., (N.O. *Burmanniaceæ*) forwarded by Mr. Rodway, from Tasmania.

Mr. Fred Turner exhibited and offered observations on *Eragrostis major* Host.(syn. *Eragrostis poæoides* var. *megastachya* A. Gray), a rather showy annual grass indigenous to Europe and Asia; but now acclimatised in North-west New South Wales, and reported to be spreading in the Tamworth and adjacent districts. Some years ago the late Mr. George B. Gidley King called the attention of the exhibitor to that exotic grass, which had then recently appeared in the pastures on Goonoo Goonoo. It is not considered of much value from an Australian stockowner's point of view. *Eragrostis major* is now naturalised on the American continent, and in other warm countries. In some of the warmer States of America, it is popularly called "Candy-grass," but for what reason the exhibitor did not know.

Mr. Froggatt exhibited specimens of a weevil (*Æsiotes leucurus* Pasc.) in illustration of its life-history, and the damage it does to pine-trees (*Pinus halepensis*). The species was described from specimens sent by Mr. Masters, in 1873, who supplied the information that it was "a pest to introduced conifers." It is, however, a rare beetle in collections, though, just now, countless thousands of them are to be seen, infesting an avenue of pines, at Strathfield.

CONTRIBUTIONS TO OUR KNOWLEDGE OF SOIL-FERTILITY.

iii.—Bacterial Slimes in Soil.

By R. Greig-Smith, D.Sc., Macleay Bacteriologist to the Society.

Many of the bacterial colonies that develop upon plates of saccharine nutrient media after sowing with dilute suspensions of soil, contain slime or gum. As the bacteria that go to form the colony are actively producing slime at the moment of their isolation, and continue to do so, it is reasonable to expect that they were capable of producing this characteristic product while they were in the soil. It is also reasonable to suppose that they had been producing slime in the soil at no very distant date, or else the slime-forming faculty would have been in abeyance. With this assumption, we should expect to find bacterial slimes in soils if the conditions were such as to prevent their decomposition by other bacteria.

The slimy colonies are various, and a simple inspection is sufficient to show that the bacteria vary morphologically according to the colony, and that the nature of the slimes is different. Some are thin, others viscous, others gelatinous. From a considerable experience with slime-forming bacteria, isolated from the tissues of plants and other material, I have no hesitation in saying that the majority of slime-forming bacteria produce galactan as their typical carbohydrate. With this knowledge to work upon, it should be easy to test the matter and, if galactans are found in soil, I submit that we are justified in assuming that they have been produced there by the action of slime-forming bacteria.

In soils, we expect to find many varieties of carbohydrates resulting from the introduction or growth and subsequent decay of vegetable matter, and there are probably many forms included in the general name of humus. One of these, xylan, has been detected by Schreiner and Shorey* by means of its hydrolytic derivative, xylose. Galactans, so far as I know, have never been detected in soils.

A rich, brown orchard soil from the Kurrajong was selected as being most likely to yield a slime in quantity, and the method of extraction was that employed by me in obtaining gum from bacterial slimes. The soil was mixed with an equal volume of water, and heated first on the water-bath, and then in the autoclave at three atmospheres' pressure for some hours. The solution was filtered, and precipitated with an excess of alcohol. Both the precipitate and the alcoholic solution were reserved for examination.

The precipitate was treated in water, and again precipitated with alcohol. It consisted of a gelatinous precipitate of a pale buff colour, which became black upon drying. Both the precipitate and the alcohol soluble matter were boiled with 5% sulphuric acid for some hours, when furfural was detected, and reducing bodies were produced. In each case, a blackish-brown, insoluble, humic powder was slowly precipitated.

The acid solutions were neutralised with barium carbonate, evaporated to dryness, picked up with water, filtered, and heated with phenylhydrazine mixture. The resulting osazones, obtained as hot-insoluble and cold-insoluble precipitates from time to time as heating progressed, were purified with water, alcohol or chloroform, as occasion suggested, and fractionated into parts of similar melting point, and crystallised again and again from alcohol of various strengths, and from water.

The final products of the separation were found to be glucosazone, galactosazone, and an osazone melting at 174°C. These were obtained both from the alcohol-insoluble gum, and from the alcoholic filtrate. Partial hydrolysis had evidently taken place during the autoclave treatment.

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* Bureau of Soils. Bulletin No. 74, Dec. 1910.

The optical activity of the products of hydrolysis was determined by preparing a fresh extract of soil (400 gr.) in the manner already described, and boiling all the substances brought into solution, with 5% sulphuric acid. After treatment with barium carbonate, basic lead acetate, sulphuric acid, and animal charcoal, a comparatively colourless solution measuring 100 c.c. was obtained. This gave the following:—

Volatile and organic matter ...	1·67 g.
Copper reduced...	2·443 g.
Equivalent to dextrose or galactose ...	1·26 g.
Rotation in 2 decim. tube...	+0·99°

From the copper equivalent and the rotation, the specific rotation of the mixture appears to be $[\alpha]_D = +39·3°$, which is so much below the specific rotation of a mixture of dextrose and galactose, that we must infer that the unknown sugar is lævorotatory. An examination of the rotation at different temperatures was kindly made by Mr. Thos. Steel, who informed me that no levulose was present.

It is advisable to prolong the heating in the autoclave, to get as much gum as possible into solution. In a preliminary experiment, the heating was given at quarter-hourly intervals, and each heating brought gum and its hydrolytic products into solution. In another preliminary experiment, an ordinary agricultural soil was used, but no hydrolysable gum was obtained by heating for one-quarter of an hour. The alcohol-soluble portion was not examined. Possibly the smaller quantity of gum had been hydrolysed.

The prolonged four hours' treatment in the autoclave made the soil distinctly acid. Fifty c.c. of a 50% extract of soil showed a faint colour to phenolphthalein with 3·75 c.c. of tenth-normal alkali, a deep colour being obtained with 5·7 c.c. It was neutral to litmus paper with 3·7 c.c. This suggested that possibly the toxic effect produced upon heating soils may be due to a formation of acid, but upon testing a few soils that had been heated for four hours at 105°C., no excess of acid could be detected by stirring up the soil to a paste with water to which varying amounts of F/10 alkali had been added.

In conclusion, we have seen that, from soil, there can be obtained a water-soluble, alcohol-insoluble substance which we call a gum, and that this, upon hydrolysis, is converted into a mixture of dextrose, galactose, and another sugar. The presence of galactan is a strong indication that the gum has had a bacterial origin, and there is every likelihood of the soil containing bacterial slimes. These are always nitrogenous, and will have an influence among the many factors that constitute soil-fertility.

THE FIBRO-VASCULAR SYSTEM OF THE APPLE (POME) AND ITS FUNCTIONS.

By D. McAlpine, Corresponding Member.

(Plates xxi.-xxv.)

In the case of fleshy fruits, such as the Apple, there is a general impression that the entire edible substance consists of a succulent mass of tissue, without any of the stringy material which occurs in other parts of the tree; and even Sachs* states that the whole edible substance is composed of fundamental tissue, as distinct from the epidermis, on the one hand, and the vascular bundles, on the other. But when one remembers that the central core of the apple is surrounded by a relatively large mass of tissue, which grows and enlarges at a comparatively rapid rate, the necessity will be readily recognised for a framework of some kind for the soft parts; and there must be vessels or cells of some sort to convey the necessary food to the living and growing tissue. In other words, there must be a skeleton to prevent collapse, and conducting tissue to convey nourishment.

This is provided for in the fibro-vascular system, which looks very elaborate and complicated as a whole (Fig. 8), but when examined in detail, it is seen to consist of a definite number of strands, which give rise to numerous branches (Fig. 12.)

General Structure of the Apple.

The structure of the mature apple will now be dealt with, in so far as it is necessary for the understanding of the distribution of the fibro-vascular bundles. It is attached to the end of the parent-branch by a longer or shorter stalk, and this is the channel through which nourishment is conveyed. If a longitudinal transverse section is made, it will show the essential parts (Figs. 2, 6).

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* Lectures on the Physiology of Plants, p. 141.

The apple, unlike many other fruits, does not merely consist of seeds enclosed in a case, but surrounding that case there is the flesh of the apple. In the centre of the flower, there is a five-chambered ovary, and each chamber encloses normally two ovules. After fertilisation, the ovules become the "pips" or seeds, so that there are five carpels constituting the true fruit, with thick fleshy walls, but the inner face of each, bounding the seed-cavity, is smooth, firm, and cartilaginous in texture.

The five carpels enclosing the seeds constitute what is known as the "core" of the apple, but there is sometimes confusion over this, since the term is loosely applied to the five chambers containing the seeds, without including the fleshy walls of the carpels as well.

In each of the five carpels there is a wall of fleshy consistence, with an inner lining of horny texture. The outer boundary line is usually distinctly marked in a transverse section (Fig. 10), and each segment is more or less wedge-shaped, tapering to a point at the centre, where they all meet.

The boundary is obvious to the naked eye, because the cells composing it are different from those on each side. On the outside, the cells of the flesh are large and bladder-like; while, on the inside, the cells are rather smaller, and more elongated. The boundary itself consists of relatively small, tangentially elongated cells; and no doubt the difference in their size from those on either side, and the consequent crowding of their contents, render them distinct.

The flesh, covered by the skin, surrounds the core, and is added in order to enhance the attractiveness of the fruit, and increase the chances of the distribution of the seeds.

While the "core" is undoubtedly represented by the five carpels, there is a conflict of opinion as to the origin of the "flesh"; and, when narrowly looked into, it is seen that the structure of the apple is not so simple as it looks.

The flesh is generally considered to be the receptacle or top of the flower-stalk, enlarged and succulent, and investing the core. But there are some botanists who regard it as a thickened calyx-tube, or even as a composite structure, consisting of a calyx-tube, with the receptacle continued inside it as a sort of lining. All these views are without any direct evidence to support them, but the one most commonly held is that the flesh of the apple is the enlarged and succulent receptacle.

The depression at the apex is known as the "eye" of the apple, where the five leaves of the calyx still persist, and sometimes the remains of other parts of the flower as well.

Transverse and Longitudinal Sections of the Apple.

If a ripe apple is cut transversely about the middle, ten green spots are observed, arranged in a circle about midway between the centre and the skin (Fig. 1). These are the primary fibro-vascular bundles or strands of the apple; and if the section is allowed to dry, these points stand out distinctly. They are evidently developed in connection with the carpels, and there is one strand opposite each of the five chambers containing the seeds, and another in an intermediate position, making ten in all.

The "core" is separated from the "flesh" by a well-marked boundary line, which is attached to the top of the stalk below, and passes into the "eye" or calyx-end above, so that it is securely fixed (Fig. 5). Since the "core" is the seed-bearing body or true fruit, that explains why the fibro-vascular bundles are developed in connection with this most important organ. As affording strong corroborative evidence that the bundles are developed in connection with the carpels, when the abnormal number of six carpels occur (Fig.

2), there are twelve bundles instead of ten; and when there are four carpels, there are only eight strands (Fig. 3). In a longitudinal, median section of the apple each of these ten vascular bundles is seen to give rise to branches, which, in turn, branch again and so on, mostly towards the outside, although there are several branches on the inside (Fig. 7). From each of these ten strands, just as they are leaving the stalk, branches are given off to the outer and inner face of the seed-cavity, so that the seeds are well supplied. The main strands, however, are associated with the "flesh," and the diverging branches towards the outside do not divide much until they approach the skin, where they form a perfect network (Fig. 19). This vascular net envelops the flesh about one-quarter of an inch from the surface, and this wonderful and hitherto unsuspected structure not only unites the entire system of vessels, but it gives rise to the innumerable plume-like branches which reach even to the skin (Figs. 8 and 20). These arise from the boundaries of each mesh of the net, and they divide and subdivide in such a luxuriant manner that the ultimate branchlets interlace and intertwine, so as to form a seemingly continuous layer of conducting tissue beneath the skin. They penetrate the parenchyma cells immediately beneath the epidermis (Fig. 15), which are particularly rich in chlorophyll, and take an active part in the nutrition of the growing and swelling fruit. Brooks,* in his article on "The Fruit-spot of Apples," observes that they fade away into the surrounding tissue—"In the small veinlets, the vascular elements become fewer and fewer, finally giving place to long narrow cells that seem to be transitional between the vascular tissue and that of the apple-pulp." In a longitudinal section, the main strands are seen to come together again just at the "eye," where they pass out into the calyx, corolla, and stamens, so that the entire flower, including the carpels, is fully supplied with vascular bundles.

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* Bulletin of the Torrey Botanical Club. Vol. xxxv., p. 423, 1908.

Vascular Bundles as a whole.

It is not always practicable to get a complete and connected view of the vascular system of any particular organ, so as to understand how it is strengthened, and how it is nourished, how the delicate cells composing it are prevented from collapsing, and how the nutritive juices are conveyed to and from each part.

In the case of "skeleton" leaves, or leaves which have been bleached, the course of the vascular bundles may be easily followed. In net-veined leaves, such as those of the apple (Fig. 18), all the vascular bundles entering them are gathered into the midrib, and branches spread thence to all parts of the leaf. The branches or veins divide and subdivide until the meshes are exceedingly small, and the ultimate veinlets end free in the substance of the leaf. Every part of the leaf is traversed by this network of channels, and, at the same time, efficiently strengthened. But while flattened leaves may be readily bleached or even naturally skeletonised, I have never found a pulpy fruit, such as the apple, with the flesh decayed, and showing the complete framework naturally. I have succeeded, however, in separating out the bundles by artificial means. A healthy and mature Five-Crown apple was placed in a weak solution of potassium hydrate for a week, during which time the soft pulpy material was gradually removed, until, at the end of the week, the strands stood out quite distinct. It was next laid out in water, and, with brush and needle, the remaining soft parts were detached, so that ultimately there remained the ten strands with their ramifications, as photographed (Fig. 8). One would hardly imagine that a tender, juicy apple contained such a network of filaments, but without them the apple could never have grown to its full size, nor acquired its succulence and flavour. How this is so, will now be briefly indicated.

It is necessary to understand how the growing apple is nourished, before the wide distribution of the vascular system can be properly appreciated. It is not simply the developing seeds, with the case containing them, which require to be nourished as in ordinary fruits, but also the much larger mass of tissue outside of that, constituting the flesh. So much growth has to be made in a comparatively short time, that the apple-tree has to store up the necessary material during the previous season, for the early spring growth. The short branches known as fruit-spurs bear the fruit-buds, which are plump and well-nourished in order to give rise to the flowers. The material stored up in the branches is passed on to the flower when it is fertilised. It is easy to tell, within a few days, when fertilisation has occurred, for the flower-stalk stiffens and begins to swell. This stiffening and thickening are due to the rush of food-materials, and after the fall of the petals the stored-up food is practically exhausted. Then the young apple is partly nourished by the parent-plant, with its fresh green leaves, and partly by its own exertions. The water containing mineral matter in solution enters from the soil, passes along the roots, and up the stem, until it reaches the fruit-spurs. Here it enters through the stalk of the fruit, and is distributed along the various channels, until it bathes the tissues wherever the fine net-work reaches. The vessels are shown in one of the strands in Fig. 17.

The amount of water contained in a ripe and sound apple is 84 per cent. on an average, so that a proper water-supply is all-important for the formation of the fruit. The fruit increases in size, not so much from the multiplication as from the enlargement of the cells; and it can readily be understood how nicely the balance must be adjusted, in order to regulate the supply. The water-stream will be directed along the main channels towards the apex of the fruit, and if the cells are overgorged, then rupture of the tissue may result; and if there is a dearth of water, a concentration of the contents of the cells may follow.

The leaves of the tree are now busy manufacturing starch, some of which will be transported in the soluble form of sugar to nourish the growing fruit, which is, however, able, to a certain extent, to provide for its own needs in this respect. The chlorophyll-containing cells of the hypodermal layer are also producing starch under the influence of sunlight, so that from these two sources—the green leaves, and the green layer of the fruit—abundance of starch is formed in a normal season. This has to be rapidly transported, when the fruit is swelling, from the place of manufacture to the tissues where wanted. The insoluble starch is rendered soluble by means of a ferment, and the use of the innumerable connected and branching veinlets in the hypodermal tissue will now be evident. In the fruit-growing season, there is a great drain upon the plant's resources; and the manufactured starch must be quickly removed, in order to make room for fresh supplies. "The solution of starch is hastened by the continual removal of the sugar produced."*

But the green apple is not merely a consumer, using the material supplied, for building up its tissues; it requires to store up material towards the period of ripening, and starch grains are invariably found in the cells of unripe fruit. "The percentage of starch in apples varies entirely with the age of the fruit; in green apples it may amount to five per cent. or more, while in the completely ripened fruit it is altogether wanting."†

The vascular bundles, as a whole, can now be understood. In a transverse section of the stalk just as it enters the fruit(Fig.11), there are ten vascular bundles, although sometimes two adjoining may become confluent. These, on entering the fruit, spread out out to form ten main trunks with numerous branches, and conveniently situated about midway between the skin and the centre.

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* Pfeffer, The Physiology of Plants. Vol. i., p.505.

† Browne, "A Chemical Study of the Apple and its Products." Pennsylvania Department of Agriculture. Bulletin 58.

The earliest branching and the most direct course is towards the carpels and the seeds, then the flesh is supplied by numerous diverging branches which unite to form a network of vessels, and finally terminate, beneath the skin, in a perfect maze of the most delicate forked veinlets. So richly is the apple supplied with a connected system of vascular bundles, that it would be difficult to find an area of any size without them.

The reason for this is evident, since the developing fruit must be richly supplied with food-materials to maintain the rapid growth. The water, containing mineral matter in solution, the so-called "crude sap," is conveyed by the wood-portion of each bundle with its vessels and tracheids. The solution of organic food-material, the so-called "elaborated sap," passes along the bast-portion with its sieve-tubes and associated cells; and by means of numerous cross-connections between the two kinds of tissues, there is a blending of the "crude" and "elaborated" saps, which results in the formation of proteid substance; and this, in contact with the living protoplasm, becomes converted into the living substance itself.

The vascular system must not be conceived of as a vast network of tubes conveying food-material to a definite terminus, but as being tapped on the way by living tissues wherever growth is going on, or storage is required. The movement of the food-materials takes place in whatever direction supplies are wanted, and, even in the same cell or vessel, there may be a flow in opposite directions at the same time.

The Skeleton.

The apple starts as a very small fruit, but gradually grows to a good size, and therefore requires a framework to support the fleshy portion. There is great variation in the size and weight of apples. Rome Beauties have reached 19 ozs., and Rymers 22 ozs., in a Victorian orchard during the past season; but the heaviest known to me grew on a six-year old tree in the same orchard. It was a Munroe's Favourite, green when picked, and weighing 2 lbs. 2 ozs. Such a mass of pulpy tissue would collapse by its own weight, unless there were some means of strengthening it. The distended cell-walls of the tissue itself would tend to stiffen the whole, just as in a firm leaf when the cells are all turgid, but strengthening rods are required as well. There are ten of these curved supports, normally equidistant from each other, diverging from the stalk at the base, and becoming united again at the top, just beneath the eye. These strengthen the whole structure, like so many curved ribs, and the various branches form lesser supports. It will be observed that this system of strengthening is not merely mechanical; it is also a living mechanism, which has to grow and expand according to the strain it has to bear.

The growth of the core and of the flesh concurrently, requires a nice adjustment of the various contributing factors. The enlarging core is richly supplied with a fine network of vessels for its own immediate use, and there are also branches stretching from it at various angles, traversing the flesh, and firmly rooted beneath the skin. As the flesh enlarges, these branches stretch in unison with it, and they are so tightly stretched that they resemble so many stays keeping the core in position. This is shown in Fig.9, where some of the strands are dissected out, and while serving as holdfasts, they also convey nourishment when required.

The skin is likewise a form of skeleton, giving firmness and consistency to the entire fruit, although its main function is to regulate transpiration. The thick-walled mother-cells of the epidermis are divided by thinner walls into more or less quadrilateral daughter-cells, and the appearance presented by them has given rise to the name of "window-cells"(Figs.13, 14). The rapid expansion of the surface is provided for, to keep pace with the internal growth, by means of these window-shaped cells; for although in uninterrupted contact with each other, when they stretch, a new window is inserted between, and thus the superficial area is increased.

Vascular bundles in relation to the Seeds.

That the vascular bundles are developed primarily in connection with the "core" comprising the carpels, and gradually spread out into the fleshy receptacle is evident from various considerations. When a coloured fluid is injected into the stalk of the apple, it first spreads out into the cavity containing the seeds and thus the "pips" or seeds are the first to be supplied with the nutritive fluid. But very striking evidence is also afforded that the development of the seed influences the growth of the fleshy receptacle, for when only some of the ovules are fertilised and produce seeds, it is found that the apple is rather one-sided. The seedless portion does not grow so rapidly as the other, because the vessels conducting the food-materials are not so luxuriantly developed. Thus the position of the bundles in the wall of the the core, their direct communication with the seeds, and their sparing development when no seeds are formed, all point to an essential relationship between the two.

But there may be overgrowth or irregular growth as well as undergrowth in the apple, according to the nature of the season. Under certain conditions of heat or moisture, the supplies coming from the roots and the leaves, together with those manufactured by the apple itself, will produce abnormal growth, especially when transpiration is not active, and the water accumulates in the cells. A well-balanced ration is just as necessary for the healthy plant as for the healthy animal, and whatever disturbs the equilibrium will tend to produce a disordered nutrition. Even the keeping quality of fruit is affected when the specimens are overgrown. Beach and Clark* in their Bulletin on "New York Apples in Storage," remark that—"It is a matter of common observation that specimens that are very large for the variety do not keep as well as those of medium size and firmer texture. This is remarked by several cold-storage men. Such fruit may be produced on young trees, or on mature trees making excessive growth, or carrying a light crop.'

Vascular bundles in relation to each other.

The primary vascular bundles in the apple, just as in other portions of the tree, do not remain isolated and disconnected, but, by the anastomoses which take place, particularly towards the periphery, there is continuity throughout. The entire system is comparable, in this respect, to the anastomosing veins and arteries of the human body, only we must be on our guard against speaking of "circulatory" tissues, or of the "circulation" of water and foods, as if there were a central organ from and to which the nutritive fluids were directed. On the other hand, we must remember that, even in the apple, there is a connected, and not a scattered system of vascular bundles (as Strasburger erroneously states), which branch out from the stalk, and distribute food-materials to every part, passing along the inner wall of each of the five chambers to supply nourishment to the seed, and then spreading out among the cells of the flesh.

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* New York Agricultural Experiment Station. Bulletin 248, 1904.

The fruit is a kind of central depôt, to which all the various ingredients, which go to make up a perfect food, are conveyed. The water containing mineral matter in solution from the root, and the starch conveyed in the soluble form of sugar from the leaves, meet and unite to form the organic food-supplies, the so-called elaborated sap, which passes through the stalk into the fruit, and there, in contact with the living protoplasm, builds up new tissue.

The fruit itself supplies an extra amount of starch, to be stored up, and utilised when ripening occurs. As the fruit ripens, this stored-up starch is gradually converted into sugar, and instead of being sour and disagreeable, it acquires the pleasant taste and delicious flavour of the world-renowned fruit of temperate climes. The sweetness of an apple, however, does not depend altogether upon an excess of sugar, as is generally supposed, but rather upon an absence of malic acid, for sour apples are frequently found to contain more sugar than fruit of a sweeter kind.* The taste of an apple, therefore, will depend mainly on the diminished acidity, but also partly on the percentage of sugar present.

Thus as the result of supplies drawn from the soil and the air, and distributed by means of a highly elaborate and effective vascular system, there is produced the shapely, coloured, nutritive, and finely flavoured apple, which contains the seed, the supreme effort of the tree's existence.

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* Browne, "A Chemical Study of the Apple and its Products," p 14.

EXPLANATION OF PLATES XXI.-XXV.

Plate xxi.

Fig. 1.—Transverse, median section of an apple, showing the ten primary fibro-vascular bundles in the form of ten greenish dots, arranged in a circle, each bundle being either opposite to, or intermediate with each of the five carpels.

Fig. 2.—Thin, transverse slice of Rome Beauty, showing twelve fibro-vascular bundles, corresponding to the six carpels. The bundles are seen branching outwardly, and becoming much subdivided just beneath the skin.

Fig. 3.—Transverse, median section of Rome Beauty, showing eight fibro-vascular bundles, when there are only four carpels.

Fig. 4.—Diagrammatic, transverse section showing how the branches of each bundle ultimately divide in a forked manner, and break up into minute branchlets, intertwining with each other just beneath the skin.

Plate xxii.

Fig. 5.—Longitudinal, median section of an apple, showing the wall of the "core" attached below to the top of the stalk, and above passing into the "eye."

Fig. 6.—Thin, longitudinal slice of an apple, showing vascular bundles running lengthwise from the stalk, along the outer wall of the "core," and the forked branches beneath the skin.

Fig. 7.—Diagrammatic, longitudinal section, showing one of the primary vascular bundles diverging from the top of the stalk, and giving rise to secondary branches supplying the "core," on the one hand, and the "flesh," on the other. The branches to the core envelop the carpels in a fine network, so that every part is reached by the conducting tissue. The various branches supplying the flesh from each of the primary bundles also form a united network extending from the "eye" to the stalk, and completely surrounding the bulk of the flesh. On the outside, the strands of this network give off plume-like branches reaching to the skin, and breaking up into innumerable, fine filaments which intertwine.

Fig. 8.—Fibro-vascular system as a whole, showing the main trunks and the numerous branches. The network of vessels is seen covering the carpels in the interior and the outer branches end in a perfect maze of branchlets beneath the skin.

Plate xxiii.

Fig. 9.—Longitudinal, median section, with the flesh surrounding the core removed. The top of the stalk is shown still attached to the core, which extends to the "eye" at the apex. From the top of the stalk, a primary vascular bundle, on each side, surrounds the core

branching inwardly and covering the seed-cavity with a fine network of vessels, and branching outwardly towards the surface.

Fig. 10.—Transverse, median section of core, showing the flower-like arrangement of the carpellary walls, and the ten primary vascular bundles associated with them.

Fig. 11.—Transverse section of stalk just as it enters the fruit, showing the ten fibro-vascular bundles. At this level, there were four bundles single, and the remaining six formed three pairs. At the base of the core, they broke up into ten distinct vascular bundles, as shown in the next figure (× 30).

Fig. 12.—Transverse section of stalk, where the vascular bundles diverge, showing ten strands radiating from it.

Plate xxiv.

Fig. 13.—Surface-view of epidermis, showing the thick-walled mother-cells divided into the thinner-walled daughter-cells, known as "window-cells," from their appearance (× 100).

Fig. 14.—Surface-view of epidermis, with the contents of the daughter-cells retained (× 100).

Fig. 15.—Cross-section through the skin of an apple, showing the epidermis and hypodermal layer into which the ultimate branchlets of the vascular bundles penetrate. There is the cuticle of the epidermis, about 12 μ in thickness, standing out clearly, and surmounted by a thin deposit of wax; the brick-shaped epidermal cells, and usually four or more layers of cells in the hypoderm tangentially elongated (× 100).

Fig. 16.—Transverse section of a fibro-vascular bundle, showing the xylem, with numerous vessels below, and the phloem with sieve-tubes above. The parenchymatous cells of the flesh adjoining the vascular bundle are usually narrower, and smaller than the ordinary cells (× 100).

Fig. 17.—Longitudinal section of vascular bundle, showing the spiral vessels of the xylem (× 100).

Fig. 18.—Leaf of apple showing midrib, with diverging veins and veinlets forming a network. The number of vascular bundles entering the petiole is three.

Plate xxv.

Fig. 19.—Oblique view of apple, with the outer flesh removed, showing the enveloping network of vascular bundles, with the projecting, plume-like branches arising from the strands of each mesh.

Fig. 20.—Plume-like branches, slightly enlarged.

Fig. 21.—General view of network and plume-like branches, with some of the flesh still adhering to the "eye"-end.

THE GASES PRESENT IN THE FLOATS (VESICLES) OF CERTAIN MARINE ALGÆ.

By A. H. S. Lucas, M.A., B.Sc.

Amongst our Australian Marine Algæ, vesicles filled with gas are found only in a few genera of the Brown Seaweeds, Fucoideæ. These are *Sargassum*, *Carpophyllum*, *Turbinaria*, *Cystophora*, *Cystoseira* (more typically a Northern genus), *Scaberia*, *Phyllospora* amongst the Sargassaceæ; *Hormosira* of the Fucaceæ; *Macrocystis*, and possibly *Adenocystis*, of the Laminariaceæ. Several receive their names from the habit.

The function of the vesicles is evidently to support the fronds in a more or less upright position in the water. In young plants, and, in sheltered situations in shallow water, in even the mature fruit-bearing individuals, there are no vesicles. This often causes difficulty in the identification of a form which normally bears characteristic vesicles.

I have not seen anywhere any account of analyses of the gases occurring in the floats of seaweeds, and have accordingly devoted some little time to this inquiry as to the nature of the gaseous content. Naturally the question of the origin of the gases is most prominent in one's mind. There seem to be three possible sources: (1) atmospheric air, (2) the gases dissolved in sea-water, (3) gases produced in the metabolism of the plants themselves. The main object of my experiments was to see if the results would decide which of the three is the actual source.

I may say, at once, that I have never detected any gases beyond nitrogen and oxygen in the floats. It is hardly conceivable that any process of metabolism should yield these two gases only, without any carbon compounds. The issue is then narrowed, and the gases must be derived from those of the atmosphere, or those dissolved in the sea-water.

I tried other methods of analysis, but found that absorption by phosphorus over water was the cleanest, surest, and readiest. Practically in a couple of hours, fresh cut phosphorus removed all the oxygen which my simple apparatus could measure. By choosing the time of the day for the experiments, the total volume and the volume of the remaining nitrogen could be determined under practically the same conditions of temperature and pressure. I do not claim any extreme accuracy for the experiments.

First, by way of testing the method, I made several analyses of atmospheric air, of air dissolved in tap-water, and of the gases dissolved in sea-water. The ratio of nitrogen to oxygen given by the apparatus for air, was the orthodox 79 : 21. To collect the gas from water, the water was boiled into a vessel containing water made previously gas-free by prolonged boiling. Thus 250 c.c. of tap-water yielded 3·9 c.c. at ordinary temperature and pressure, of which 2·6 c.c. were nitrogen, and 1·3 c.c. oxygen. The ratio of the nitrogen to the oxygen was then 2 : 1, as it should be if all the gas were dissolved from atmospheric air, inasmuch as oxygen is twice as soluble as nitrogen. There was no carbon dioxide.

The analyses of sea-water gas varied considerably, as might be expected. On referring to the analyses of South Pacific Surface Water collected by the "Challenger," I found that of 16 analyses published in the Report, no two were alike. The carbon dioxide varied from 10·18 to 23·12 per cent. of the total gas. The ratio of nitrogen to oxygen varied from 62·43 : 26·59 to 54·51 : 28·64, evidently varying about a mean of 2 : 1. It would seem that the presence of organisms alters considerably the natural ratio of the gases dissolved from the air. One of the analyses I obtained was—

In 100 vols. of sea-water gas

Nitrogen	67·12
Oxygen	26·03
CO_2	6·85
	100·00

The water was wave-water taken off the shore at Bondi, on the ocean beach. 250 c.c. of sea-water yielded 3·65 c.c. of gas, or at the rate of 14·6 c.c. per litre. The "Challenger" average was 15 c.c.

Another analysis of Coogee ocean-water gave—

In 100 vols. of sea-water gas	
Nitrogen	58·33
Oxygen	30·55
CO_2	11·11
	99·99

This is almost identical with a "Challenger" analysis.

The following is a Table of the analyses of the gases of the floats of some of our algæ.

Species.	Percentage of Nitrogen.	Percentage of Oxygen.	Comments.
Phyllospora comosa (1)	86·0	14·0	Fresh-looking plants cast up on the shore.
,, ,, (2)	89·4	10·6	Just cast up.
,, ,, (3)	88·9	11·1	,,
,, ,, (4)	82·3	17·7	,,
,, ,, (5)	83·2	16·8	,,
Hormosira banksii (1)	88·46	11·54	Growing.
,, ,, (2)	88·0	12·0	Same gathering kept a day longer.
Cystophora monilifera	80·0	20·0	Floating in the sea.

The analyses disappointed me, for I, perhaps unreasonably, hoped for nearly uniform results. With the exception of the last, however, it will be seen that in all the proportion of oxygen is less, usually much less, than if air had been taken directly into the cavity, and in all the proportion is notably less than in air dissolved in water.

The proportion of oxygen being then less than in ordinary air, and much less than in water-dissolved air, it would seem that the plants, however they may obtain the gas, use up some of the oxygen, sometimes a good deal, for other purposes than levitation.

The analyses give no decisive evidence as to which of the two possible sources of supply is the actual one. The gases as found may be residues of either ordinary or water-dissolved air. The plants, while in the main submerged, are at low water as large waves retire, exposed to the air. *Hormosira* may often be left quite exposed at low tide. The vesicle is always closed; there are no passages or pores in the walls. The structure of the walls is as continuous as that of the rest of the frond. The vesicle originates in a solid growth from the frond, the growing cells gradually separating from the centre and leaving a central cavity. Hence diffusion from the air seems to be excluded, for the gas must be formed in the cavity, *pari passu*, with its growth, otherwise the vesicle would collapse. Hence we seem to be driven to osmosis, or osmosis with selective absorption, as the process by which the gas passes, dissolved in water, through the cells of the plant until the residue is set free in the cavity. Algæ obtain all their nourishment, including the oxygen necessary for respiration, from the surrounding sea-water, and there must exist a circulation from cell to cell, which I have termed, perhaps rather crudely, a selective osmosis. It is in this way that the plants obtain their salts, with a marked preference for potassium sulphate, and their oxygen, and it seems perfectly natural that just as common salt is very generally rejected, not absorbed, so the useless nitrogen, together with the oxygen not required, may be eliminated, and set free in the floats in order to serve a mechanical purpose. All the surface of the plant can be employed in the initial absorption, and in many individuals the great number of the floats seems to require some such general agency. I consider, then, that the source of the gases is the gas dissolved in the surrounding sea-water.

The Gases of the Inflated Capsules of two Land-plants.

It was suggested to me by Mr. T. Steel, that I should examine, as a parallel investigation, the gaseous contents of the Balloon Vine, *Cardiospermum Halicacabum* L., plants of which were growing in his garden. He kindly supplied me with sufficient of the balloons, freshly gathered from the vine. A single balloon yielded over 10 c.c. of gas.

No evidence could be obtained of the presence of carbon dioxide above the amount ordinarily present in air. There was no evident absorption by potash; and though the gas was allowed to stand over lime-water for six hours, not the slightest film of carbonate formed on the surface.

Three separate determinations of oxygen were made by the phosphorus method. Simultaneously with the third sample of gas, an equal volume (10 c.c.) of air was tested under practically the same conditions of temperature and pressure The results were—

Gas No. 1.	Oxygen 20·3 %.	Using	graduated	vessel	A.
Gas No. 2.	Oxygen 19·0 %.	,,	,,	,,	B.
Gas No. 3.	Oxygen 20·0 %.	,,	,,	,,	A.
Air.	Oxygen 19·0 %.	,,	,,	,,	B.

It seems plain, then, that the gas is identical with ordinary air, the difference in reading being probably due to the slightly unequal graduations of the two measuring vessels.

The balloons were of a vivid tender green The outer surface has a distinct epidermis provided with hairs and stomata. There is no inner epidermis, the lining tissue having the same loose structure as that of the septa dividing the capsule. It is plain, then, that atmospheric air can be admitted under the control of the guard-cells of the stomata, and can penetrate all the loose tissues of the thin capsule-walls, passing through to the cavity within. As the balloons were gathered in the early morning, it would seem that any free carbon dioxide formed during respiration passes out of the stomata, and does not accumulate inside the capsule.

The use of the balloons is apparently to allow of the distribution of the capsules by the wind. They are easily detached when ripe, and from their shape can be rolled along the ground as well as carried in the air. And the plant secures the gas necessary for inflation by the readiest means from the handiest supply. *i.e.*, the surrounding atmosphere.

While staying at the entrance to the Tuggerah Lakes, I gathered the inflated capsules of the Wild Cotton Plant, *Gomphocarpus fruticosus* R. Br., and made parallel analyses of the contained gas, and of the air of the place. In the former I found 21 % of oxygen, and in the latter 21·1 %. This also shows that the cavities were filled with air drawn directly from the atmosphere.

Portuguese Man of War.

At the same place, I found a number of Portuguese Men of War freshly thrown up on the ocean beach, and tested the gas of the floats in the same way. It appeared to be identical with the atmospheric air analysed at the same time. Here diffusion seems to be the process by which the float is filled, the growth of the cells providing the necessary cavity. The membrane appears to be thin enough for diffusion to be able to act.

ORDINARY MONTHLY MEETING.

November 29th, 1911.

Mr. W. W. Froggatt, F.L.S., President, in the Chair.

The President reminded Candidates for Fellowships that Thursday, 30th inst., was the last day for sending in applications.

The Donations and Exchanges received since the previous Monthly Meeting (25th October, 1911), amounting to 7 Vols., 66 Parts or Nos., 29 Bulletins, 4 Reports, and 7 Pamphlets, received from 53 Societies, &c, and two Individuals, were laid upon the table.

NOTES AND EXHIBITS

Mr. D. G. Stead showed: (1) An aboriginal "Nulla-nulla" which he had obtained from a fork in a giant river "Red Gum," *Eucalyptus rostrata*, on the banks of the Murrumbidgee River at Grong Grong Station, a few miles above Narrandera. The weapon had apparently been deposited in the tree by a high flood, as there was a certain amount of silt as well as silted leaves and sticks; while there was dried river-mud on the object itself. (2) The skull of an aboriginal Australian which had recently been picked up by some fishermen on top of a mound of sand at the back of the sea-beach at "The Gibber," a small headland a little to the southward of Broughton Island. (3) A number of examples of the seaweed known as "Balloon-weed," "Bubble-weed," or "Bladder-weed," *Colpomenia sinuosa*, attached to oysters, cockles, and pieces of Black Mangrove. At certain seasons and in some localities this weed is one of the worst and most troublesome of oyster-pests. At the present time it is particularly bad on certain oyster-leases at Wallis Lake. The plant grows over the oysters, and then as the "balloons" grow larger and gas forms within them, the whole is floated to the surface and carried off by the tide either to be lost in deep water (after the collapse of the plant), floated on to another man's lease, or to be drifted up to the limits of high tide among floating débris. It is rightly looked upon as one of the worst and most insidious of "oyster-thieves."

Mr. Basset Hull exhibited, on behalf of Mr. L. Harrison, a skin of the Cape Petrel, *Daption capensis* Linn., which was captured alive at Turimetta Head, Narrabeen, on the 15th October last. The bird was sitting on a ledge of rock above high water-mark, and, though apparently uninjured, seemed incapable of flying. It lived in captivity for nine days, on each of which it was placed in a large bath of water for a couple of hours, and fed upon small morsels of fat. This last was not taken solid, but was macerated with the aid of its beak; and the water, with its floating film of fat, greedily taken up. Gould mentions that this petrel follows up ships and feeds on fatty matter thrown overboard, so that it may be freely taken with a hook baited with fat; but it seems improbable that solid fat is ever swallowed, as a few fair-sized morsels, which were bolted by the bird at its first meal, when it was very hungry, were found undigested in the stomach after death. After feeding for about an hour, the bird would spend almost another hour in bathing, and in preening itself. While in the water, the bird floated high up, and its legs hung loosely, and were turned out at an angle of 45° from the sagittal plane. The webbed feet were worked slowly outwards, the effect being to keep the body practically stationary. Exposure to the sun on the very hot tenth day was too much for the petrel, which was found dead. *Daption capensis* does not appear in Mr. North's list of the birds of County Cumberland, nor in the two supplementary lists published in the Records of the Australian Museum; nor does there appear to be any record of its occurrence on the coast of New South Wales, though it is frequently seen out at sea. Mr. Harrison also sent, for exhibition, four specimens, adult and young, together with an egg-case attached to a feather, of *Ancistrona procellariae* Westwood, the largest known mallophagan parasite of birds, from the *Daption capensis* Linn., mentioned above. The genus and species were described by Westwood in 1874, both description and figure being inadequate; and apparently it has not since been taken from the type-host. A similar form, taken from *Fulmarus glacialis*, was described, in 1885, by Piaget as *Ancistrona gigas*. Kellogg has taken an *Ancistrona* from several petrels, which he has referred to *A. gigas* Piaget. Recently Dr. Harvey Johnston and Mr. Harrison received an *Ancistrona* from *Pelagodroma marina* from the Kermadec Islands; and in a paper before the New Zealand Institute, now in the press, expressed the opinion that only one species of *Ancistrona* is so far known, and that it must be called *A. procellariæ* Westwood. The present material, collected from the same host as Westwood's type, substantiates this opinion; as it is undoubtedly identical with the form described by Piaget as *A. gigas*.

Archdeacon Haviland exhibited a so-called 'Mulga-ball, composed of the impacted, indigestible, fibrous matter of the twigs of the Mulga (*Acacia aneura* F.v.M.), from the intestine of a sheep. Also an egg of a Mallee-Hen (*Lipoa ocellata* Gould), which he had taken from a mound-nest in the Cobar district.

Mr. E. J. Bickford showed a flowering specimen of *Nuytsia floribunda* R.Br.,[N.O. LORANTHACEÆ] the Christmas Tree of West Australia.

Mr. Cheel, on behalf of Mr. Maiden, communicated the following Note:—"At the Meeting of the Society on September" 27th, Mr. F. Turner exhibited a "Blue Couch"(*Panicum didactylum* Kunth), "which is said to have caused the deaths of a number of pasture animals near Muswellbrook, Upper Hunter, N.S.W., in 1907, as reported in the papers." I enquired into the matter at the time, examined and took specimens of the suspected grass in various localities, but on no occasion was the above-mentioned grass shown to me as suspected. I determined the grass as the common Couch (*Cynodon dactylon* L. C. Rich.), but it now turns out to be the closely allied *Cynodon incompletus* Nees, a South African or East African grass, according to Dr. Stapf of Kew, which I now exhibit and record, for the first time, as introduced into Australia (Muswellbrook, N.S.W.). I also show detailed drawings, and point out that the most obvious difference between the two species is "rhachilla produced" in

C. dactylon, and "rhachilla not produced" in *C. incompletus*. Mr. Cheel exhibited dissections of the flowers of the two species at the Society's Meeting in August last, but at that time there was here a lack of means of correctly recognising the species with "the rhachilla not produced," which Dr. Stapf has now kindly done."

Mr. Cheel also exhibited a fresh flowering branch of *Brachychiton populneo-acerifolium*, a hybrid described by the late Baron von Mueller in the Society's Proceedings for 1884(p.381). The original tree was growing at Fernlea, Mulgoa; and a specimen, raised from seed obtained from this plant, 20 years ago, is growing in the Botanic Gardens, Sydney, and is flowering freely at the present time. The colour of the flowers is what is known as "vieux rose." He also exhibited a small log of *Correa Lawrenciana* Hook., 4-5 inches in diameter, from a shrub 10-12 feet high, which branches much from the base; from Dromedary Mountain, N.S.W.(J. L. Boorman).

Dr. J. M. Petrie demonstrated Guignard's new method of detecting hydrocyanic acid compounds in plants. Taking Sorghum as an example, he showed that, with a plant 6 feet long, positive results were obtained from root, stalk and seeds, but that *leaves* gave no reaction until emulsion, prepared from sweet almonds, was also added. The leaves, therefore, contained the glucoside only, but no ferment. It was suggested that, though such leaves would be non-poisonous, yet if eaten in conjunction with certain other plants, which might contain ferment, the toxic effects would at once ensue, by the setting free of hydrocyanic acid in the digestive organs. The Egyptian grown Sorghum is known to become non-poisonous when over 12 inches long, whereas the local grown plant 5-6 feet long contained much poisonous glucoside. Dr. Petrie also stated that he was engaged in a systematic examination of the Australian flora for cyanogenetic compounds.

Mr. Froggatt showed a number of living larval stages of the Great Leaf-insect of Ceylon, feeding upon leaves of the Mango.

ON A COLLECTION OF PARASITIC HYMENOPTERA (CHIEFLY BRED), MADE BY MR. W. W. FROGGATT, F.L.S., IN NEW SOUTH WALES, WITH DESCRIPTIONS OF NEW GENERA AND SPECIES. PART ii.

BY P. CAMERON.

(Communicated by W. W. Froggatt.)

CHALCIDIDÆ.

Chalcidinæ.

CHALCIS FROGGATTI, n.sp.

Black; anterior tibiæ in front, and their base and apex behind, middle knees and tarsi testaceous; hind femora behind and the upper two-thirds, basal third and apical third of tibiæ red; hind tarsi paler than the others; hind femora closely punctured, their teeth numerous, closely pressed together; wings hyaline, the nervures black. Length, 4 mm.

Kenthurst, N.S.W.; in August(W. W. Froggatt).

Head umbilically punctate, more coarsely above than along the sides of front. Pro- and mesonotum umbilically punctate, scutellum more coarsely than mesonotum; metanotum coarsely, irregularly reticulated, the sides broadly rounded. Upper part of propleuræ roundly convex, transversely aciculated, bordered at base by a broadly rounded, curved furrow, widest below. Mesopleuræ bordered by a row of large, round foveæ, upper part smooth on basal half, apical weakly striated, this part projecting below the basal; the part under the latter covered with round deep punctures, base of apical punctured below, like the basal part but more sparsely. Metapleuræ coarsely reticulated.

CHALCIS EUPLŒÆ Hope.

An Indo-Malayan species of wide range. Bred from *Antheræa simplex;* Richmond River, N.S.W.(W. W. Froggatt).

CHALCIS POMONÆ, sp.n.

Black; head and thorax densely covered with short, white pubescence, abdominal segments on the sides fringed with long, white hair; tegulæ, apex of four front femora and base of their tibiæ narrowly, apex of tibiæ more broadly, apex of hind femora, base and apex of tibiæ (about one-third), central black part a little longer than the coloured base and apex, which are of equal length, and tarsi, white; femoral teeth short, blunt, the basal larger than the others; there are about ten teeth, covered with white pubescence; wings hyaline, the nervures black. Length, 7 mm.

Bred by Mr. W. B. Stokes, at Glen Innes, from the Codling Moth (*Carpocapsa pomonella*), the imported moth so destructive to apples.

Closely, rather strongly, umbilically punctate; puncturation on central lobe of mesonotum stronger than on lateral, on scutellum still stronger; the apex of the latter projecting and transverse; metanotum irregularly, coarsely reticulated; the central basal area somewhat semicircular, bounded by a small square one on either side, the outer area much larger, transverse, its apex broadly projecting in the middle; base bordered by a row of small areæ, longer than wide, and of equal width; sides broadly rounded. Abdomen smooth, shining, longer than head and thorax united, gradually narrowing from the second segment to the apex.

This is not a typical *Chalcis;* the apex of the scutellum is transverse and the abdomen longer and more distinctly narrowed than *e.g.* in *C. euplœæ.* Its precise generic location may be left over until the male has been discovered. The abdomen shows an approach to *Conura* and *Phasgonophora.*

IRICHOHALTICELLA, gen.nov.

Abdomen sessile, basal segment nearly as long as the following segments united, closely, strongly, uniformly, longitudinally striated, except on the outer edge, which is smooth and clearly separated; it is longer than it is wide at the apex, which is broadly rounded outwardly; the second is, from the form of the first, much longer laterally than in the centre, where it is about one-fourth of the length of the first; its apex is not quite transverse. Antennæ placed over the mouth, 10-jointed, the joints elongate. Hind femora closely toothed, the apical tooth larger than the others. Apex of scutellum bluntly rounded. Metanotum flat, bearing three keels on either side, three being connected by finer transverse striæ; outer keel stouter than the others and slightly projecting. Apex almost transverse above and at the top, pressing against the broad base of the first abdominal segment. Submarginal nervure nearly one-half the length of the rest of the wing; submarginal not one-fourth of its length, stigma short, hardly projecting beyond the latter; postmarginal hardly differentiated. Malar space as long as the eyes. Body and legs more densely pilose than usual. Middle legs much narrowed on the basal half.

A genus of *Halticellinæ*, easily known by the peculiar form of the first abdominal segment.

IRICHOHALTICELLA PILOSELLA, sp.n.

Black; densely covered with white pubescence; the apical third of the four anterior femora, the whole of the posterior, and all the tibiæ and tarsi red; wings hyaline, nervures black, tegulæ black, broadly red on the outer edge. Length, 5 mm.

Mittagong, N.S.W.; caught on the wing(W. W. Froggatt).

Antennæ opaque, bare, third joint about one-quarter longer than fourth, the last longer than the penultimate. Sides of front and occiput coarsely, umbilically punctate, the lower part of front with the sculpture hidden by the dense pubescence, the middle coarsely transversely striated. Temples less strongly umbilically punctate. Pro- and mesonotum, except laterally, and scutellum coarsely umbilically punctate, lateral lobe of mesonotum with the central apical half smooth, the rest with large, distinctly separated punctures. Base of metanotum, under the projecting apex of the scutellum, with a crenulated furrow; the two outer longitudinal areæ wider than the central, and having the longitudinal and transverse keels stronger than the central. Upper half of propleuræ umbilically punctate, clearly separated from the lower, which is smooth, has a stout keel down its base, but not on the basal edge; it has two longitudinal upper and lower keels. There are two rows of punctures on the apices of the third and fourth abdominal segments, the others being opaque, and finely rugose.

ANTHROCEPHALUS MARGINICEPS, sp.n.

Black; the four anterior knees and tarsi rufo-testaceous; wings hyaline, the apical half tinged, slightly, but distinctly with fuscous, the nervures black; face, outer orbits, apex of mesopleuræ, metapleuræ and the sides of the apical abdominal segments densely covered with long silvery pubescence, the rest of the body with the silvery pile shorter and sparser, except on the mesonotum, where it is short and black; legs covered with white pubescence, which is dense, especially on the femora and tibiæ. The last abdominal segment and the sheath of the ovipositor covered densely with a short white pile. ♂♀. Length, 5 mm.

Mittagong, N.S.W.; in January; caught on the wing (W. W. Froggatt).

Antennæ longish, of uniform thickness. Frontal depression finely, closely transversely, regularly striated to the anterior ocellus, which is placed inside it in a smooth shining space; it is bordered by a stout keel, the space between which and the eyes is regularly, rather closely, and strongly striated. Occiput closely, almost transversely, not very strongly rugosely punctured, the punctures on the top larger, and more distinctly separated. Pro- and mesonotum, and scutellum moderately strongly punctured, the punctures on the mesonotum more widely separated. Metanotum bordered by a stout keel, commencing at the outer basal part, where it is roundly dilated, forming almost an oblique semicircle from which it runs obliquely to the lower central part, forming a triangular area; the keel has two outward projections inside it. In the narrowed basal part, are some oblique striæ, the innermost larger and rounded inwardly; on the base is a crenulated furrow; the area is bare, but it is fringed densely by long silvery hair. Pleuræ strongly punctured, the depressed basal part of the mesopleuræ bare, shining, strongly striated, the striæ clearly separated, the central more irregularly sloped than the others. Seen from the top, the metanotum, on the outer edge, is trilobate, the central lobe larger and more rounded. Apex of fifth tarsal joint of hind legs and claws, except at apex, rufous.

ANTHROCEPHALUS ERYTHROGASTER, sp.n.

Black; antennæ, tegulæ, legs and abdomen, except the back, and ovipositor, red, antennæ of a paler red colour; wings hyaline, nervures black. Frontal depression closely, regularly, not very strongly striated, separated from the anterior ocellus by a smooth, slightly curved, flat keel; it is separated from the eyes by a broad band which, on the inner side, bears three rows of punctures below, two above; the innerside is obliquely depressed towards the eyes, and has two rows. Thorax on the pro and mesonotum and scutellum closely, regularly, not very strongly punctured; apex of scutellum margined, the centre with the keel stronger and depressed in the middle, forming two slight lobes narrowed inwardly. The centre of the metanotum has, on either side, a stout keel, which runs from the outer basal part to the inner central, the two forming a large triangular area. ♀. Length, 5 mm.

Glen Innes, N.S.W.; bred by Mr. W. B. Stokes, in January, from "Codling Moth."

Closely, almost uniformly, not very strongly punctured. The narrowed, apical part of the scutellum margined, furrowed on the inner side, the centre of the apex broadly bilobate, the lobes not prominent. The depressed part of the mesonotum striated, the striæ moderately strong, more or less curved, bordered at the base and apex by a smooth margin. Abdomen as long as thorax, the terminal sheath short, broad, blunt at the apex. The end-joints of the antennæ are marked with black. Hind-femora finely, closely, distinctly and uniformly punctured; below they are margined by white pubescence.

ANTHROCEPHALUS CARPOCAPSÆ, sp.n.

Black; flagellum of antennæ, tegulæ and legs red, tibiæ darker in tint than the femora; wings hyaline, nervures black; a fuscous cloud at and behind the stigma, not extending much beyond the nervures; beyond is a larger, paler, longish-triangular cloud, the narrowed end at the costa, it extending beyond the middle. Basal four ventral segments piceous-red. Frontal depression deep, faintly striated, the sides transversely striated, with two longitudinal keels, the inner stronger and longer than the other, it going round the sides and top of the lower ocellus; opposite the latter, it forms a flat, smooth, shining keel on which are three foveæ. Pro- and mesonotum closely, distinctly punctured, the former more finely and closely than the latter, scutellum slightly more strongly than the mesonotum, its apex depressed in the middle, the sides bluntly rounded. Metanotum with a slightly oblique, straight slope; in the centre are two keels, which slightly converge at the base, the space between them irregularly striated; the part on either side of this is reticulated, widely at the base, more finely and closely at the apex, the part becoming gradually narrowed towards the apex. Abdomen as long as the thorax, becoming gradually narrowed towards the apex. ♀. Length, 4 mm.

Bred from "Codling Moth"(*Carpocapsa pomonella*), by Mr. W. B. Stokes, at Glen Innes.

ANTHROCEPHALUS SPILOGASTER, sp.n.

Black; the basal two abdominal segments, upper half of third, on the sides, and hind coxæ, trochanters, and femora red; wings hyaline, the middle of the wings fuscous, slightly violaceous, the cloud fainter beyond the stigma, which is black like the nervures; the four anterior tarsi are rufo-testaceous except at the base. ♀. Length, 6 mm.

Bong Bong, N.S.W.(W. W. Froggatt).

Temples, pleuræ, metanotum, and apices of abdominal segments densely covered with long, white pubescence; mesonotum and scutellum densely with shorter black pubescence; the pubescence on the tibiæ short, white and dense. Frontal depression closely, regularly, transversely striated in the centre; sides transversely striated, with a keel on either side, and one down the centre. Malar space as long as the eyes. Apex of scutellum roundly, broadly incised, the lateral edges bluntly rounded. Thorax strongly punctured, the punctures on the mesonotum and scutellum clearly separated. Mesopleuræ, except at the base, closely, regularly, longitudinally striated, the striæ becoming shorter below. Metapleuræ closely, rugosely reticulated, armed with a stout tooth, which is longer than wide at the base. Abdomen nearly as long as head and thorax combined.

ANACRYPTUS FERRUGINEUS, sp.n.

Ferruginous; antennæ lighter in tint; mesonotum, scutellum, mesosternum, and the dilated apical part of the abdomen infuscated, the two hinder legs darker in tint than the four anterior; abdominal petiole fully one-half the length of the thorax, and longer than the rest of the segments united; wings hyaline, very iridescent, nervures black. ♂. Length, 5 mm.'

Mittagong, N.S.W.; in January; caught on the wing (W. W. Froggatt).

Head and thorax strongly, umbilically punctate, less strongly and more sparsely on the sides of the vertex and in the middle of the occiput, lateral lobes of mesonotum less strongly and more sparsely than the middle one; scutellum as strongly, but not so closely, its apex broadly rounded, and with a distinct margin Propleuræ with two punctures above and two below. Mesopleuræ, at the top apical part, with a squarish, smooth space, having one fovea in the middle of the base and three below; apical basal part closely, finely, longitudinally striated, more strongly and less closely at the top; the rest is strongly punctured, with the punctures clearly separated. Metanotum strongly aciculated, with two keels slightly diverging at the apex, in the centre. Metapleuræ regularly reticulated. Abdominal petiole aciculated, more strongly at the base than apex, its sides margined, weakly so on apical half, the sides with two stout keels, and an irregular one on basal half between them.

CHALCITELLA PICEIVENTRIS, sp.n.

Black; antennal scape and four front legs rufo-testaceous, hind legs and tegulæ of a deeper, darker rufous colour, the middle of the femora broadly black, sides and ventral surface of the dilated abdominal segments piceous-red; wings hyaline, iridescent, nervures pale testaceous, costal nervures paler at the apex. ♂. Length, 3 mm.

Mittagong; in January; caught on the wing(W. W. Froggatt).

Vertex weakly punctured laterally, the centre smooth, sides of the front more strongly punctured, occiput smooth and shining. Pro- and mesonotum and scutellum strongly punctured, apex of mesonotum smooth at the sides. The flat metanotum is strongly aciculated; there are two keels, not very clearly defined, down the middle; on either side are two pairs of not very clearly defined, oblique keels. Pro- and mesopleuræ irregularly punctured, the apical upper third of the latter smooth, the lower part finely, closely striated. Metapleuræ regularly reticulated. Abdominal petiole one-half the length of thorax, and longer than the rest of the abdomen. There are two keels on the top, and a stout one down the middle of the sides. There are eight black teeth on the hind femora, the four basal larger and more widely separated than the apical.

Toryminæ.

CALLIMONE ACACIÆ, sp.n.

Green; thorax tinged with blue, face and malar space tinged with golden, antennal scape green, flagellum black; trochanters, base and apex of femora narrowly, and tibiæ and tarsi, yellow, almost white; wings hyaline, nervures black. ♂♀. Length, 2 mm.; terebra, 1·5 mm.

Erina, N.S.W.; bred from small, berry-like galls on the foliage of *Acacia* sp.; 28th August (W. W. Froggatt).

Face strongly punctured, more weakly above than below, and more sparsely in the middle above; a keel runs down its middle from the antennæ, it becoming widened below. Vertex and front sparsely punctured, their sides transversely striated, the latter more strongly than the former; the space below the ocelli aciculated only. Mesonotum finely, closely transversely striated. Base of scutellum transversely, the sides finely and closely longitudinally striated, the apex in the middle more finely transversely striated. Base of metanotum with a crenulated furrow, centre almost smooth, sides with some oblique striæ. The top of propleuræ with a few oblique stout striæ running from the base to the apex, the rest more finely and closely striated, the striæ running from the apex to the base. Upper basal half of mesopleuræ finely striated, the striæ more or less curved. Metapleuræ smooth, the lower half depressed, rounded above, the sides margined. Abdomen smooth above, the sides finely, closely, obliquely striated. Legs closely covered with white pubescence; hinder coxæ closely, finely reticulated; hinder femora finely punctured.

MEGASTIGMUS SULCICOLLIS, sp.n.

Yellow; mesonotum, scutellum, and abdomen tinged with fulvous, legs of a paler yellow colour; flagellum of antennæ darker, more fulvous in tint, the apices of the joints narrowly black; wings hyaline, nervures testaceous, stigmal spot longish-conical. Tips of mandibles and sheath of ovipositor black. ♀.Length, 1-2·5mm.; ovipositor as long as the body.

Richmond, N.S.W.; bred from galls in the flowers of the "Kurrajong," in August (specimens from C. T. Musson).

Smooth, pronotum finely, closely, transversely striated; a narrow transverse furrow before the middle, a shorter, wider, more distinct one at the apex. Pro- and mesonotum, and scutellum sparsely covered with longish black hairs; finely, closely, transversely striated, metanotum more coarsely striated. Base of mesonotum, base and sides of scutellum and of metanotum, the sides of the latter more broadly, base of the parapsidal furrows, and the depressions at the sides of the mesonotum, black.

POLMON OLENUS Walk.

Mon. Chal. ii., 7.

Sydney; in February; bred from egg-cases of Mantis: Cooma, N.S.W.(W. W. Froggatt).

PODAGRION SPILOPTERION, sp.n.

Dark blue; abdomen dark violaceous, hind tibiæ and femora black, tarsi testaceous, antennal scape fulvous; wings hyaline, nervures black, a large blackish-violaceous cloud on the marginal nervure, commencing near its base and reaching to near the apex, enclosing the stigmal nervure, becoming slightly, gradually widened to shortly beyond the middle, then roundly narrowed, the sides at the apex rounded, the centre transverse; it extends to the top of the apical third; ♂ ♀. Length, 3 mm.; ovipositor, 2 mm.

Cooma, N.S.W.; bred from egg-cases of Mantis (W. W. Froggatt).

Face closely, finely punctured, intermixed with fine striæ; the blue colour intermixed with brassy and rosy tints, especially below. Front and vertex more strongly punctured; the punctures close and regular. Mandibles darker red, brighter in tint at the base. Pro- and mesonotum, and scutellum closely punctured; the scutellum with more distinct brassy tints; upper part of basal mesopleuræ strongly, obliquely striated, it forming a triangle, bordered below by a keel; the rest of it closely, finely reticulated. Propleuræ closely, finely punctured, more or less striated. Metapleuræ finely, closely, punctured; there are about six irregular teeth, the basal three larger and more widely separated; they are as long as the coxæ, which are closely and more finely punctured than the femora.

The male is similar. As is usual with metallic species, the amount of the brassy and rufous tints varies. The fore tibiæ may be testaceous at the base and apex, as well as below.

Probably the femoral teeth vary in size and number, as I have noticed to be the case with another species. The apical joints of the antennæ form a not very clearly defined club. The sides of the metanotum are bounded by a smooth furrow, inside of which is a flatter one, double its width, which, again, is bordered on the inner side by an irregularly crenulated furrow. The central part is finely rugose, divided into two almost equal parts by a narrow smooth furrow; the apical part is depressed in the middle.

Except for the large alar cloud, this species does not differ from typical *Podagrion*, which have long been known to live in the egg-cases of Mantis.

Perilampinæ.

PERILAMPUS TASMANICUS, sp.n.

Dark blue, largely tinged with violaceous, head with the violaceous tints more extended than they are on the thorax; a fiery red spot on the apex of the mesonotum on the sides, and another on the apex of the mesopleuræ above the middle; the ventral abdominal segments are lighter, more greenish in tint; apex of the second, and the apical dark red, the third green; legs dark blue to the apex of the femora, hind tibiæ almost black; knees, base and apex of tibiæ, and tarsi testaceous; wings hyaline, nervures dark fuscous; antennæ black, densely covered with white pile; the underside fuscous. ♀. Length, 3 mm.

Hobart, Tasmania, (A. M. Lea).

Head somewhat strongly striated; striæ clearly defined, longitudinal on the vertex and front, roundly curved on the top of the former; occiput more closely and finely, transversely striated. Pro- and mesonotum and scutellum umbilically, rather strongly punctate, basal slope of the pronotum smooth; metanotum irregularly, obliquely striated. There is an oblique keel down the propleuræ before the middle, dividing the part into two, the basal (and smaller) irregularly striated, the apical smooth. Mesopleuræ with a quadrate, smooth depression, longer than wide, on the upper basal half of the mesopleuræ; the rest longitudinally striated. Metapleuræ rugosely reticulated.

Eurytominæ.

EURYTOMA BRACHYSCELIDIS, sp.n.

Black, covered with whitish pubescence; trochanters, apex of femora, tibiæ and tarsi pale testaceous, oral region and almost the upper half of the propleuræ rufo-testaceous; base of antennal scape testaceous, underside of flagellum fuscous; the latter densely covered with a microscopic white pile; wings hyaline, nervures dark fuscous. The male has the face, clypeus, the lower outer orbits, and the malar space testaceous. ♂♀.Length, 1·5-2·5 mm.

Stawell, Victoria; bred from coccid (*Apiomorpha*) galls on *Eucalyptus* sp.(C. Daly).

Antennæ in ♀ short, thick, second joint twice longer than wide, becoming gradually widened towards the apex, scape distinctly narrower than it, the other joints wider than it is long, the last conical, the narrowed part of the joints in ♂ testaceous; the hairs are stiff, and longer than the joints. Marginal nervure as long as the postmarginal, and thicker than it; stigmal shorter than the latter, the lower thickened part semicircular, emitting a branch from the apical basal part. Parapsidal furrows shallow, but distinct. Abdomen smooth and shining, the apical segments fringed with white hair.

This is probably a variable species. The face in the ♀ may be broadly testaceous, the femora may be black, or black-testaceous below. The fourth abdominal segment occupies the greater part of the abdomen. The testaceous mark on the pronotum varies in size; it is not visible from above. The tarsi may be infuscated to a greater or less extent in the middle. There is no distinct club on the antennæ in ♀, all the joints being of equal width to the base of the last. The abdomen is distinctly shorter than the thorax; it is almost sessile, the petiole being very short.

EURYTOMA CLELANDI, sp.n.

Black; oral region, underside of antennal scape, lower half of the upper inner orbits broadly, outer orbits, the upper part gradually narrowed, malar space, mandibles, palpi and propleuræ entirely, rufo-testaceous; legs of a paler testaceous colour, the four anterior femora slightly, posterior broadly black above; wings hyaline, nervures black behind, testaceous in front; marginal vein distinctly longer and thicker than the postmarginal; the stigmal as long as the latter, its thickened apex obliquely narrowed from the base and apex to the centre, the two parts being of equal size; it has no projection. ♀. Length, 2 mm.

West Australia; bred from Coccid galls (*Apiomorpha* sp.) in January, (Dr. J. B. Cleland).

The second joint of the antennæ is longer than wide, and is distinctly narrower than the third, which is almost twice its length and distinctly wider than it; it is twice longer than wide; the other joints shorter, wider than long. The pubescence is white and dense; it is much longer on the metanotum. Head and thorax coriaceous, the pro- and mesonotum more or less transversely striated; the mesopleuræ finely, closely, obliquely striated; the metapleuræ much more coarsely striated. Parapsidal furrows straight, oblique, distinct. There is an aciculated line down the middle of the scutellum. The ventral surface of abdomen and the lower half of its sides are testaceous.

A coccid is a new host for the *Eurytomidæ*. They have been bred from *Hymenoptera, Coleoptera, and Diptera,* and one group feeds on the eggs of *Orthoptera.*

CHROMEURYTOMA, gen. nov.

Antennæ short, clavate, apparently 13-jointed, placed over the mouth, the last joints forming a club. Apex of clypeus rounded. Face roundly convex, clearly separated laterally, below separated from the clypeus by a furrow. Head distinctly wider than the thorax. Eyes large, widely separated above, not converging. Temples short. Prothorax large, quadrate, as long as the mesothorax, which has distinct furrows; these are straight, and converge towards the apex. Scutellum large, longer than it is wide at the apex; that is, broadly rounded and margined. Postscutellum large, narrowed gradually behind. Metanotum short, little developed, the centre depressed narrowly, the sides broadly rounded, the slope oblique. There is an oblique furrow across the mesopleuræ. Abdomen shorter than thorax, longish-oval, distinctly narrowed at base and apex, not petiolated. Marginal nervure long, the postmarginal longer than it; stigmal fully one-half the length of the marginal. Legs stout, pilose. Body metallic-green; its sculpture fine.

I can refer this genus only to the *Eurytominæ*, but it is certainly not typical of that group. The marginal nervure, for example, is much longer, the sculpture much finer, and the antennæ shorter and more clavate. I cannot place it in any other group. The metallic colour is not unique for the *Eurytominæ*, for it is found in *Chryseida*. In habits, the type of the genus agrees with most *Eurytominæ*, the species of the tribe being mostly parasitic on gall-insects. Probably the discovery of the male may throw light on the systematic position.

CHROMEURYTOMA CLAVICORNIS, sp.n.

Dark green, largely tinted with blue, and, to a less extent, with violaceous; antennæ, and legs, except the coxæ, rufotestaceous; mandibles and palpi testaceous; wings hyaline, nervures pale testaceous. ♀. Length, 4·5 mm.

Bungendore, N.S.W.; bred from Eucalyptus galls; August, (W. W. Froggatt).

Vertex below the ocelli finely, closely striated; apex of pronotum, mesonotum and scutellum finely, closely striated, the striation stronger on the scutellum, weaker on the base of mesonotum; post-scutellum microscopically striated, the parts bordering it fiery-red, Metanotum smooth. Metapleuræ fiery-red. Abdomen smooth. Apex of pronotum narrowly fiery-red. There is a wide curved furrow on the malar space. Ventral surface of abdomen largely violaceous.

I am not sure but that the deep rufous tint of the legs may be caused by discolouration through the action of cyanide of potassium.

XANTHEURYTOMA, gen. nov.

Submarginal nervure twice the length of marginal, thickened towards the apex, marginal thickened, postmarginal not one-half the length of marginal, not longer than stigmal, which is triangularly thickened at the base, at its junction with the marginal, the lower part of it narrowed, roundly curved. Antennæ short, thick, joints of flagellum wider than thick. Ocelli almost in a straight line, the central very little in front of the lateral. Parapsidal furrows clearly defined, rounded, meeting very shortly before the base of scutellum. Scutellum large, longish-pyriform, the broad end at the apex; almost as long as the mesonotum. Metanotum short, steeply oblique; the centre with a keel on either side, the two parallel not converging. Thorax not punctured, only very finely striated above. Abdomen sessile, distinctly shorter than thorax; its second segment much longer than the others; its apex bluntly rounded, broad; fifth segment shorter than fourth.

There is no clear club to the antennæ; the joints of the flagellum are not distinctly separated, at the most only pilose; the scape is narrower than the flagellum; it does not extend much above the middle of the eyes; there are eleven joints; the front is not much depressed.

Comes near to *Xanthoroma,* Ashm., which may be known from it by the fifth, abdominal segment in the ♀ being nearly twice as long as the fourth, by the abdomen being longer than the thorax, and by the marginal nervure being once and one-half longer than the stigmal, not twice longer. The parapsidal furrows are deeper, more clearly defined and more roundly curved than in *Eurytoma;* the scutellum, too, is larger, and much more narrowed at the base than in that genus.

XANTHEURYTOMA FLAVA, sp.n.

Yellow; back of thorax deeper, more fulvous in tint; centre of the whole of the basal slope of pronotum and the thoracic sutures more or less black, flagellum of antennæ tinged with fulvous, legs a paler yellow than the body; wings hyaline, nervures testaceous, the dilated parts darker-coloured; stigmal nervure triangularly dilated at the base, the apical part a little longer than it, roundly curved. The metanotum and back of abdomen may be infuscated. ♂. Length, 2 mm.

Richmond, N.S.W.; bred from galls in the flowers of the Kurrajong (C. T. Musson).

Occiput transverse. Hinder ocelli separated from each other by twice the distance they are from the eyes. The occiput may be infuscated more or less; it is obscurely striated Mesonotum and scutellum finely, closely, transversely striated. Parapsidal furrows distinct, roundly curved towards each other at the apex, where they unite and are joined to the transverse scutellar furrow by a short one. Scutellum large, ovate, twice longer than wide, obliquely narrowed to a point at the base, the apex broadly rounded.

Probably a variable species, as regards the amount of black.

Eupelminæ.

EUPELMUS ANTIPODA Ashmead.

Proc. Linn. Soc. N. S. Wales, 1900, 342.

Sydney; in September. Dorrigo; in September. Bred from egg-cases of a small Mantis.

This appears to be a variable species as regards colouration; some specimens have more of the green tint than others; the blue merges into violaceous, and these may be brassy tints. The male is green with brassy tints, and, on the metanotum, the green merges into violaceous; the antennal scape and four front legs are yellow tinged with fulvous, especially on the femora; the hind legs are coloured as in the female, except that the femora are green for the greater part; and the tibiæ are not so deeply black, while their base may be testaceous. The colour of the wings varies, some having the fuscous tint on the apical two-thirds, much lighter than others; in the males they may be almost hyaline.

Tridyminæ.

TEPPERELLA, gen.nov.

Antennæ short, stout, thickened towards the apex, apparently 12-jointed, the basal joint of the flagellum longer than broad, the apical shorter; head wider than the thorax; the temples little developed, occiput broadly incised. Ocelli in a curve, the hinder separated from each other by two-thirds the distance they are from the eyes. Clypeus triangular, longer than it is wide at the apex, which is transverse. Pronotum distinctly, but not largely developed, gradually widened towards the apex. Mesonotum with the furrows distinct, roundly curved; its middle lobe larger than the lateral, wide at the apex, which is bounded by a transverse furrow. Scutellum large, nearly as long as the mesonotum, gradually narrowed from the apex to the base, the apex bluntly transverse. Metanotum short, obliquely sloped. Abdomen broadly ovate, bluntly rounded at the apex, shorter than the thorax. Marginal nervure short, thick, about one-quarter longer than the stigmal branch; postmarginal thinner, and twice longer. Spurs short. Legs normal. There is a distinct longitudinal furrow near the top of the mesopleuræ, extending from base to apex.

Wings large, shortly ciliated round the apex. Malar space as long as the eyes. Apex of clypeus transverse. The front is little depressed. Top of antennal scape reaching close to the ocelli. Body smoother than usual, being almost without sculpture. Scutellum larger than usual, somewhat pyriform, narrowed to a point at the base. Metathorax short; no keel on the metanotum.

I can refer this genus only to the *Tridyminæ*, Tribe *Tridymini*. In the system of Ashmead (Mem. Cair. Mus. i, 274) it runs near to *Semiotellus*.

TEPPERELLA MACULISCUTIS, sp.n.

Rufo-testaceous; head, except for a triangular spot on the face, the greater part of metanotum and the abdomen, black; antennæ black, flagellum testaceous below, scutellum with a longish-triangular black mark in the centre; wings clear hyaline, nervures testaceous. ♀.Length, 4 mm.

South Australia; bred from long, slender, horn-like galls on *Eucalyptus leucoxylon* (J. G. O. Tepper).

Smooth, shining; head, pronotum, metanotum, and apical abdominal segments sparsely haired.

Cleonyminæ.

PARAHEYDENIA, gen.nov.

Antennæ slender, not thickened towards apex. Front wings with a small cloud on the costal nervure at the base of its apical third; a larger cloud at, and touching the stigmal nervure; marginal nervures twice the length of stigmal; postmarginal thickened, and projecting beyond the apex of the latter. Occiput transverse, temples obsolete above. Ocelli in a triangle. Eyes large, parallel; malar space distinct. Pronotum a little longer than the mesonotum without the scutellum, the centre raised, widened towards the base, sides with a large, oval depression below the raised centre; it is distinctly narrower than the mesonotum, which is flat, narrowed in front and without furrows. Scutellum large, flat, wider than long, rounded at the base, the apex transverse; metanotum short, rounded, a keel running down the centre, and one on either side of this on the apical half; sides bordered by a keel. First abdominal segment campanulate, longer than wide, the narrowed end at the base; second the longest, longer than the following united, the segments becoming gradually widened to the penultimate, the whole being shorter than the thorax. Fore-femora greatly swollen, straight on the lower, roundly, broadly narrowed on the upper side; base in front slightly depressed in the middle, middle femora more slender than the hinder, as are the middle tibiæ than the posterior. Second joint (pedicle) of the antennæ about twice longer than wide, third double its length, fourth about one-quarter shorter, the others shorter, fifth and sixth twice longer than wide, the others wider than long. Parapsidal furrows almost obsolete.

This genus fits in best into the *Cleonymınæ*, and probably is most nearly related to *Heydenia*, a genus which appears to be very little known. It is stated by Foerster to resemble one of the *Dryinoidæ*, which is certainly the case with the present genus. In *Heydenia*, the parapsidal furrows are indicated; there are no keels on the metanotum nor clouds on the wings.

PARAHEYDENIA LONGICOLLIS, sp.n.

Upper part of head and thorax brassy-golden, sutures blue; pleuræ similarly coloured, but more largely tinged with blue, especially below; abdomen dark purple, the base blue, the middle laterally tinged with golden-brassy; legs dark red, four hinder coxæ purple, tarsi testaceous, basal joint white; antennal scape red, pedicle brassy, the other joints black; wings hyaline, nervures black, an oval fuscous cloud at the stigma. ♂. Length, 4 mm.

Wagga, N.S.W.; in April (W. W. Froggatt).

Antennal furrows wide, converging and uniting above, dark green, closely reticulated-punctured, as is also the vertex; the rest of the head more finely punctured. Ocelli in an equilateral triangle, the hinder separated from each other by a slightly greater distance than they are from the eyes. Pronotum finely, closely transversely striated; pleuræ smooth. Mesonotum and scutellum closely, rather strongly, reticulated-punctured, the lateral divisions more finely than the central; mesopleuræ more finely, similarly punctured, more finely so at the base, where there is a raised longish area, the narrowed end above; apex bordered by a smooth line. Metanotum smooth in the middle; there is a stout keel down its centre, with a less distinct one, bulging out in the middle, on either side of it; the sides are aciculated, and as are also the metapleuræ, densely covered with white pubescence. Coxæ and the dilated fore-femora closely, finely punctured; the former densely covered with white pubescence. Mandibles red, black at the apex. Palpi white.

THE FIBRO-VASCULAR SYSTEM OF THE PEAR (POME).

By D. McAlpine, Corresponding Member.

(Plates xxvi.-xxix.)

I have already dealt in some detail with the vascular system of the apple (*antea*, p.613), and it is so closely related to that of the pear, that it will not be necessary to treat the latter with the same degree of fulness.

The fruits of the apple, pear, and quince, known as *Pomes* or Pip-fruits, are characterised by possessing five carpels, constituting the "core" or true fruit, and surrounded by a fleshy portion generally considered to be the swollen and succulent receptacle. The pulpy flesh of the pear and quince differs from that of the apple, however, in containing groups of what are known as "stone-cells" scattered among the thin-walled cells of the parenchymatous tissue. These constitute the "grit" of the pear and quince, and consist of cells with strongly thickened, lignified walls, hence called sclerenchyma.

Transverse and longitudinal Sections of Pear.

If a thin transverse section of the pear is made through the core, and phloroglucin used as a stain, followed by hydrochloric acid, the stone-cells turn a bright red colour; and while seen to be scattered through the flesh, extending even to the skin, they are densely clustered around the core(Fig.2). The pear likewise differs from the apple in being more or less top-shaped, so that the carpels are relatively nearer the crown or blossom-end, and not so central because there is a much larger proportion of the fruit representing the receptacular portion beneath the core(Fig.4). On this account, the primary vascular bundles are seen traversing the flesh for a greater portion of their course than in the apple, and a better insight is thereby gained into their relative positions before they reach the carpels.

The pears used in this investigation were Harrington's Victoria and Achan, because they happened to be preserved up to the month of September. It was found that, in the case of the pear, potassium hydrate was not necessary for softening purposes, as, *after immersion for five days in ordinary tap-water*, the skin could be easily peeled off, and the flesh removed by needle and brush, so that the vascular system stood out distinctly as shown in Figs.6, 7, and 8.

If we follow the course of the vascular bundles from the fruit-stalk, a connected view will be obtained from their entrance into the fruit, and they can then be followed right through until the blossom-end is reached.

Fruit-stalk.—The fruit-bud which is borne by the short shoot or "spur," will open out in the spring into a number of flowers, of which only one may "set" and produce fruit. The flower is really of the nature of a shoot, and the stalk represents the stem or axis. If a transverse section of the stalk is made just where it adjoins the flesh, ten distinct fibro-vascular bundles are seen (Fig.1), although, on account of irregularities in growth, these may often lose their distinctness, and run together. They are continued into the fruit, and constitute the ten primary vascular bundles which supply the rapidly growing fruit from the parent-tree.

Vascular System of "Core" and "Flesh."

A transverse section of the pear through the "core" shows the five cavities, each containing normally two seeds, enclosed by a fleshy wall with a firm inner face(Figs.2, 3). An irregular layer of "stone-cells" surrounds this, so that the ten vascular bundles, seen so prominently in the apple between and opposite to each of the carpels, are obscured. How densely the stone-cells are crowded, particularly opposite the carpels, may be seen in Fig.3. But if a transverse section does not reveal much of a vascular system from mere inspection, a longitudinal section gives a good insight into the general structure(Figs.4, 5). The continuation of the fruit-stalk is seen in the flesh, and the primary vascular bundles soon diverge from it. There are five bundles only slightly spreading at first, but as they approach the carpels, they bulge out more. As each one approaches its corresponding carpel, it gives rise to an internal branch, which passes along the dorsal or outer face of the carpel, while the main portion of each bundle is continued beyond to the blossom-end of the fruit. There are also five alternating bundles which diverge a little higher up than the preceding, and each one passes between two carpels, giving off an internal branch to the inner or ventral face of the carpel (Fig.6).

Each primary vascular bundle gives rise to numerous branches externally, which combine to form a complete network of vessels about one-half inch or less from the surface(Fig.9); and from the boundaries of each mesh, the innumerable plume-like branches arise, reaching to the skin, just as in the apple(Figs.4, 5, 6).

Fibro-vascular System as a whole.

The first impression gained by a glance at this luxuriant and elaborate system of vascular bundles in the pear(Fig.7) is, that it is provided with a most complete framework to support the soft parts, and is the centre of a great receiving and distributing agency, receiving food-materials from every part of the tree, and distributing them to every portion of the fruit. It is not only adapted for supplying present needs, but also for future requirements, as the food is used up or stored up, according to circumstances.

It is difficult to give an accurate description, conveying an idea of the diversity of the bundles and yet of their combination into a harmonious whole. But the general views of the entire system (Figs.7 and 8), the detailed views(Figs.6 and 9), together with the transverse and longitudinal sections(Figs.2, 3, 4 and 5), should help to give a vivid picture of the wonderful arrangements provided by nature for the building up of the luscious fruit, which is simply a vehicle for the distribution of the seeds.

The Skeleton.—Just as in animals, the skeleton is intimately associated with the conducting tissues, and each fibro-vascular bundle has a skeletal framework to stiffen and strengthen the vessels. In addition to that, the "stone-cells," so generally distributed throughout the pear, strengthen and protect the softer tissues, and being scattered in groups, they offer no impediment to increase in size. Even the skin, as shown in the account of the apple, acts as an outside skeleton, or exoskeleton, to give firmness to the whole, and keep the component parts together. If the skin is broken or bruised in a ripe pear, it is seen how quickly decay sets in; and even while the fruit is still growing, the skin must keep pace with the rapid enlargement. The structure of the skin, with its "window-cells," as in the apple (Fig. 10), is adapted for expansion, but its chief function is to prevent a too rapid loss of water. As showing the efficiency of the skin for this purpose, I had a pear of the Broompark variety and a Jonathan apple, peeled and unpeeled, and kept in a dry atmosphere for 48 hours. The loss in weight was carefully tested by P. R. Scott, Chemist for Agriculture, with the following results:—

Weight of whole pear before desiccation .....261·569 gr., after 260·0355 gr.
Weight of peeled pear before desiccation.... 176·677 gr., after 172·5190 gr.
Weight of whole apple before desiccation. 133·4895 gr., after 132·737 gr.
Weight of peeled apple before desiccation ..112·065 gr., after 108·8538 gr.

No. 1. Whole pear........ 0·586 per cent. loss after 48 hours.
No. 2. Peeled pear........ 2·35 ,, ,, ,,
No. 3. Whole apple....... 0·563 ,, ,, ,,
No 4. Peeled apple....... 2·87 ,, ,, ,,

Thus the peeled pear had lost over four times the weight of that of the whole pear, and the pared apple had lost over five times that of the unpared.

The Conducting Tissue.

If we follow the course of the nutrient fluid, supplied by the root, stem, and leaf, from its entrance through the stalk, to nourish the fruit, it will give us a connected view of the whole system. This food is conveyed through ten primary bundles developed in connection with the carpels, although the fleshy portion, which is only accessory to the true fruit, is also nourished through them. The ten primary vascular bundles alternate with each other. Five of them are arranged opposite the five carpels, and each one gives off an internal branch as it approaches the carpel, to supply its outer or dorsal surface, and this conveys the nourshiment through a network of delicate branches radiating on either side of each carpel (Fig. 6). The main bundle is continued around the carpels to the blossom-end of the fruit.

The remaining five bundles run between the carpels (Fig. 6 in centre), and convey the nourishment to the inner or ventral face of each carpel. An internal branch is given off towards the base of each primary bundle (about ¾ inch from the top of the stalk), and these five branches run together in the centre until they approach the tapering basal end of each carpel. There each branch splits up into two parallel strands, which run along each side of the ventral face of the carpel, and these ten strands are clearly shown in Fig. 3. These also branch, and form a network on the surface of each carpel, so that, from the dorsal and ventral surfaces, there is a system of vessels which blend and leave no portion unprovided for (Figs. 5 and 6). As in the others, the main trunks pass around the carpels to the blossom-end.

There is here a beautiful illustration of the principle of the division of labour, for five of the vascular bundles, opposite the carpels, supply the dorsal surface of each; while five, between the carpels, provide for the ventral surface of each, and by a delicate system of branching, the entire surface of the carpel is liberally supplied with nutritive material. The ten strands, running alongside the ventral portion of the carpels, are continued along their whole length, for they are seen in sections either towards the base or the apex of the carpels.

While the seed-cavity, with its contained seeds, is the most important, and must be directly supplied, yet there is the most liberal provision made for the "fleshy" portion of the pear. From the outer surface of each primary vascular bundle, numerous branches are given off, which divide and subdivide until they form a complete network surrounding the "flesh" (Fig. 9); and from the boundaries of each mesh, innumerable plume-like branchlets are given off, ending in their delicate intertwining tufts immediately beneath the skin. Here a *new supply of food-material is provided for, for* the green chlorophyll-containing cells of the hypodermal layer (Fig. 12), in the presence of sunlight, manufacture starch, which is converted into sugar, and carried by the plume-like branches to the enveloping network, where it meets and blends with the ascending stream.

As regards the course followed by the food-materials, the most generally accepted theory is that the carbohydrates and the proteid substances follow two separate paths in their passage from the place of formation, the one through the "conducting parenchyma," and the other by means of the sieve-tubes.

But the view that these substances are exclusively conveyed in particular tissues is becoming modified, and Sachs, in his "Lectures on the Physiology of Plants," states at p.358, "In the case of a very vigorous transport of starch, as when the leaves of trees are being emptied in the autumn, even the phloem of the vascular bundles may take part in it."

The theory put forward by Czapek, in 1897, that the carbohydrates are transported by the sieve-tubes, is now gaining ground, particularly when they have to be carried for some distance. There are thus two possible ways in which food-materials may be transported—by the slow process of diffusion from cell to cell, when the solutions in each have different degrees of concentration; or more rapidly by means of the sieve-tubes, with their greater length, and pores in the transverse walls.

Vascular bundles in relation to each other.

It has finally to be noted, that the primary vascular bundles are not isolated from each other, but that they anastomose at various points. The branches which supply the core and the flesh ultimately form a network, the one enveloping each carpel (*Fig.* 6), and the other the flesh at a short distance from the surface (Fig. 9).

There are thus two main systems connected by means of a network of vessels, corresponding to the two principal constituents of the pome; and this wonderful vascular net, which is seen in the young fruit immediately after the petals have fallen, as well as in the mature fruit, is evidently for the purpose of regulating and equalising the distribution of the nutrient fluid to the seeds and the flesh respectively.

While the network is an evident means of intercommunication, there are other less conspicuous connections, such as the branches given off to supply the carpels being directly connected here and there by *cross-partitions* with the main bundles.

EXPLANATION OF PLATES XXVI.-XXIX.

Plate xxvi.

Fig. 1.—Transverse section of fruit-stalk, just as it enters the fruit, showing ten fibro-vascular bundles. The stalk was somewhat shrunken on account of the age of the fruit, and the section shows the woody tissue ruptured in nine of the ten bundles (× 30).

Fig. 2.—Transverse section of pear through the carpels near the blossom-end, showing the distribution of the "stone-cells." The section was placed in a solution of phloroglucin to which hydrochloric acid had been added, and the lignified walls of the stone-cells were stained a bright red.

Fig. 3.—Transverse section of portion of pear, similar to the preceding, showing the central core, with two bundles alongside of each other between the carpels. The indications of the ten primary bundles are not seen as in the apple, being obscured by the surrounding "stone-cells," which form very prominent groups opposite each of the carpels. The pair of bundles adjoining the inner face of each carpel represents the forking branch from each of the five intermediate main bundles (× 2).

Plate xxvii.

Fig. 4.—Longitudinal median section showing the "core" towards the blossom-end. The primary bundles are seen diverging from the stalk-end, and continuing round the carpels to the blossom-end; while, on the left side, the network is seen, together with the

plume-like branchlets radiating towards the skin. The dots scattered through the flesh indicate the stone-cells. (Slightly reduced).

Fig.5.—*Diagrammatic longitudinal section, showing the primary vascular* bundles diverging slightly from the base, and passing towards the blossom-end, giving off branches on the outside, which form a network with plume-like branchlets radiating towards the skin. The primary bundles are alternately opposite and intermediate to the carpels, and give off branches on the inside supplying each of the carpels dorsally and ventrally.

Fig.6.—Fibro-vascular bundles supplying two carpels, the two outer bundles being opposite to, and the inner one between the carpels. Each vascular bundle is seen branching outwardly, forming a network with plume-like branchlets, while, on the inner side, branches are given off to the carpels. The primary bundles, opposite to the carpels, branch and supply the dorsal face of each carpel, while those intermediate supply the ventral face.

Plate xxviii.

Fig.7.—General distribution of the vascular bundles, as shown when the skin is removed, and the flesh of the pear carefully detached. The main trunks, with their innumerable branches, ramify through every part, and form a complete outline of the fruit. (Slightly reduced).

Fig.8.—Same specimen as in Fig.7, with the various primary bundles spread out so as to expose the carpels. Each bundle is continued around and beyond the carpels to the blossom-end of the fruit. (Slightly reduced).

Plate xxix.

Fig.9.—Vascular network of *Achan* pear, a short distance beneath the skin, enveloping the flesh. The variable size and shape of the meshes are shown, as well as the plume-like branchlets. (Slightly reduced).

Fig.10.—Surface-view of skin of pear, showing the "window-cells," as in the apple, but somewhat smaller (× 100).

Fig.11.—Cross-section through skin and flesh, showing epidermis and hypodermal layer, together with groups of "stone-cells" in the flesh (× 100).

Fig.12.—Cross-section of skin, showing thickened outer walls of epidermal cells (stained by fuchsia), and hypodermal layer with cells tangentially arranged, and vascular bundles reaching to them (× 100).

A REVISION OF THE AUSTRALIAN SPECIES OF THE GENUS *CERCERIS*.

[*Hymenoptera.*]

By Rowland E. Turner, F.Z.S., F.E.S.

As the descriptions of the Australian species of *Cerceris* are rather scattered, and some of them very insufficient, I think it may be useful to give a brief revision. There doubtless remain many species yet undiscovered, the dry conditions prevalent over a large part of Australia being eminently suitable for this genus. But I do not think it will prove to be so well represented as in North Africa and India; for the section of the genus characterised by a raised plate at the base of the second ventral segment seems to be entirely absent from Australia. Many of the species show the broad orange bands so characteristic among Australian Aculeata; the genus being especially liable, in almost all countries, to assume the prevalent colours The species from Adelaide and Western Australia seem to be very little known, several of Smith's types being still unique in the British Museum Collection; and the species I myself have described are, with one exception, from Queensland. I have been able to consult the types of all the species except the common *C. australis* Sauss. Where the original descriptions are sufficient, I have not thought it necessary to go into minute details in the present paper. I have not given a key to the males, partly because the number known is small, but also because I do not wish to give facilities for describing new species from the males alone, a practice which is undesirable in this genus.

♀♀. *Key to the Australian species of Cerceris.*

1. Mesopleuræ with an acute spine; black, second and fifth abdominal segments orange.........	*C. varipes* Sm.
Mesopleuræ without an acute spine, tuberculate or simply rounded..................................	2.

2. Mesopleuræ tuberculate or subtuberculate........ 3.
Mesopleuræ without tubercles, simply rounded. 7.
3. Clypeus with a tubercle on each side near the middle, depressed from the middle to the apex.. 4.
Clypeus without tubercles........................... 6.
4. Pronotum subemarginate anteriorly; colour almost entirely black, except on the apical abdominal segments .... 5.
Pronotum transverse; orange, the mesonotum and third and fourth abdominal segments black.. *C. victrix* Turn.
5. Pronotum with a minute spine on each side; thorax and median segment shining and sparsely punctured. Length, 12 mm......... *C. perkinsi* Turn.
Pronotum without spines; thorax and median segment closely punctured. Length, 22 mm. *C. froggatti* Turn.
6. Enclosed area of the median segment smooth; black and yellow, with obscure ferruginous markings on the thorax.......................... *C. inexpectata* Turn.
Enclosed area of the median segment finely transversely striated; orange, mesonotum, apex of median segment and fourth abdominal segment black.............................. *C. fluvialis* Sm.
7. Clypeus with a free lamina springing from the base or above the middle............................ 8.
Clypeus with the lamina free only at the apex, if at all.. 9.
8. Lamina of the clypeus free from the base, longer than broad; orange, mesonotum and fourth abdominal segment black.......................... *C. aurantiaca* Sm.
Lamina free from near the middle, short; black rather sparingly marked with yellow.......... *C. opposita* Sm.
9. Enclosed area of median segment smooth......... 10.
Enclosed area of median segment not smooth... 11.
10. Clypeus porrect, widely and deeply emarginate; abdomen smooth and shining.................. *C. euchroma* Turn.
Clypeus less strongly porrect, shallowly and not widely emarginate; abdomen punctured...... *C. multiguttata* Turn.
11. Abdomen almost smooth; petiole and third segment black, remaining segments fulvous...... *C. australis* Sauss.
Abdomen more or less strongly punctured........ 12.
12. Petiole much broader than long; black marked with orange-red .... *C. gilesi* Turn.

Petiole subquadrate or longer than broad; markings yellow or ferruginous, not orange-red...	13.
13. Petiole about one-half as long again as broad....	*B. prædura* Turn.
Petiole subquadrate, either a little longer than broad or a little broader than long............	14.
14. Enclosed area of the median segment obliquely striated almost to the apex..........	*C. labeculata* Turn.
Enclosed area striated only in the angles, if at all	15.
15. Clypeus strongly porrect at the apex	*C. venusta* Sm.
Clypeus scarcely or not at all porrect at the apex	16.
16. Fourth and fifth dorsal abdominal segments more sparsely punctured than the basal ones	*C. sæva* Sm.
Fourth and fifth dorsal segments as closely punctured as the rest.	17.
17. Third dorsal segment black..........	*C. antipodes* Sm.
Third dorsal segment yellow and ferruginous....	*C. minuscula* Turn.

CERCERIS AURANTIACA Sm.

Cerceris aurantiaca Sm., Ann. Mag. Nat. Hist.(4), xii., p.414, 1873,♀.

♀. Aurantiaca, fronte circa ocellos, mesonoto, mesopleuris, sterno, segmento abdominali dorsali quarto, segmentisque ventralibus quarto quintoque nigris; alis subhyalinis margine costali infumatis; clypeo lamina libera, porrecta, arcuata, latitudine multo longiore. Long. 12 mm.

♂. Feminæ similis; vertice, segmento mediano, segmentoque quinto dorsali etiam nigris; clypeo convexo, latitudine longiore.

♀. Clypeus with the lamina free from the base, arched, twice as long as the breadth at the apex, truncate at the apex, the sides almost parallel, sparsely but deeply punctured, the apical margin of the clypeus below the lamina very shallowly emarginate. Antennæ inserted at least twice as far from the anterior ocellus as from the base of the clypeus, the second joint of the flagellum distinctly longer than the third. Pronotum not rounded at the angles, mesopleuræ without spines. First abdominal segment nearly twice as broad as long; pygidial area about twice as long as broad, the sides nearly parallel, truncate at the apex, the surface very finely granulate; ventral segments 3-5 with an impressed median line. Closely and rather coarsely punctured; scutellum, postscutellum and ventral segments 2-4 almost smooth; enclosed area at the base of the median segment smooth, with short striæ at the base and divided by the usual longitudinal groove.

♂. Clypeus convex, longer than broad, without a free lamina, truncate at the apex. Antennæ inserted only about one-half as far again from the anterior ocellus as from the base of the clypeus; pygidial area narrowed towards the apex.

Hab.—Adelaide, S.A.

CERCERIS FLUVIALIS Sm.

Cerceris fluvialis Sm., Ann. Mag. Nat. Hist.(4), xii, p.412, 1873,♀.

♀. Aurantiaca, macula circum ocellos ad oculos attingente, mesonoto, pleuris, sterno, segmento mediano dimidio apicali, segmentoque abdominali quarto nigris; alis flavo-hyalinis, apice obscuris; clypeo ante apicem subtuberculato; mesopleuris minute tuberculatis; segmento mediano area basali delicatissime transverse striata. Long 12 mm.

♀. Clypeus convex and subtuberculate below the middle, then triangularly and subconcavely depressed to the apex, much broader than long. Antennæ inserted very low down, more than twice as far from the anterior ocellus as from the base of the clypeus, second joint of the flagellum very little longer than the third. Mesopleuræ with a very small tubercle; pronotum rounded at the angles; first abdominal segment twice as broad as long; fifth ventral segment widely and shallowly emarginate at the apex, the ventral segments without a depressed median line; pygidial area broadest at the base, about one-half as broad again at the base as at the apex, twice as long as the greatest breadth. Closely and not very deeply punctured; pronotum, mesonotum, scutellum and postscutellum shining and almost smooth; enclosed area at the base of the median segment finely transversely striated; ventral segments of the abdomen very finely punctured, the three basal segments almost smooth.

Hab.—Swan River, W.A.(Du Boulay).

CERCERIS VARIPES Sm.

Cerceris varipes Sm., Ann. Mag. Nat. Hist.(4), xii., p.413, 1873,♀.

♀.Nigra; clypeo, margine interiore oculorum latissime, tegulis macula, tarsisque intermediis flavis; segmentis dorsalibus secundo quintoque fascia latissima, femoribus apice, tibiis, tarsisque anticis et posticis aurantiacis; clypeo lamina apice libera, porrecta, apice leviter incisa; mesopleuris spina curvata armatis; segmento mediano area basali longitudinaliter striata; segmentis ventralibus 2-5 linea longitudinali mediana impressa; area pygidiali triangulari, elongata; alis hyalinis, costa obscura. Long. 16 mm.

♀.Mandibles with two very blunt teeth at about one-third from the apex; clypeus broader than long, the lamina free at the apex and porrect, shallowly incised in the middle. Antennæ inserted twice as far from the base of the clypeus as from the anterior ocellus, second joint of flagellum half as long again as the third. Mesopleuræ armed with a curved spine; first abdominal segment nearly twice as broad as long; ventral segments 2-5 with an impressed longitudinal line in the middle; pygidial area elongate-triangular, more than twice as long as the breadth at the base, the surface granulate. Vertex closely and shallowly punctured, mesopleuræ more coarsely punctured, enclosed area at the base of the median segment closely longitudinally striated; the rest of the insect more or less shining, minutely punctured.

Hab.—Adelaide, S.A.

I have seen only the type of this fine species, which may easily be distinguished by the spine on the mesopleuræ, and the conspicuous colouring.

CERCERIS FROGGATTI, sp.n.

♀.Nigra; clypeo macula basali, scapo apice, margine interiore oculorum latissime, macula parva pone oculos, tegulis macula, segmento dorsali secundo macula laterali, tertio lateribus, quarto linea basali excepta, quinto sextoque fulvo-ferrugineis; segmentis ventralibus 3-6 basi latissime ochraceis; alis subhyalinis, margine costali fuscis; clypeo apice depresso, in medio porrecto et late emarginato, angulis denticulatis; mesopleuris bituberculatis, seg-

mento mediano area basali nitida; femoribus apice, tibiis tarsisque fusco-ochraceis. Long. 22 mm.

♀. Clypeus strongly depressed from the middle to the apex, apical margin truncate, the raised basal portion slightly porrect and broadly emarginate, with a well defined tooth on each side at the angles of the emargination. Antennæ inserted more than one-half as far again from the anterior ocellus as from the base of the clypeus, second joint of flagellum one-half as long again as the third. Head very large, emarginate on the posterior margin, the cheeks a little broader than the eyes. Pronotum not rounded at the angles, without a depression in the middle; mesopleuræ with two small tubercles; first abdominal segment nearly twice as broad as long; pygidial area nearly twice as broad at the base as at the apex, gradually narrowed, and broadly rounded at the apex, twice as long as the greatest breadth, the surface granulate; posterior trochanters with a spine beneath. Head, thorax and median segment closely but not very deeply punctured; the enclosed area at the base of the median segment smooth and shining, with the usual dividing groove; abdomen opaque and sparsely and finely punctured on the dorsal surface, smooth on the ventral surface.

Hab.—Rockhampton, Q. (H. Brown; received from Mr. Froggatt). Type in British Museum.

Nearly allied to *C. perkinsi* Turn., but in that species the thorax and median segment are much more sparsely and finely punctured, the abdomen more coarsely punctured, and the pygidial area not narrowed to the apex; the posterior trochanters without a spine and the tubercles on the mesopleuræ less distinct. The size and colour are also different; but the form of the clypeus is very similar. This is the largest known Australian species of the genus.

CERCERIS PERKINSI Turn.

Cerceris perkinsi Turn., Trans. Ent. Soc. London, 1910, p. 423, ♀, Pl. l., fig. 12.

♀. Nigra; macula utrinque ad clypei basin, et scapo subtus flavis; segmentis abdominalibus 4-6, segmentoque dorsali secundo

macula basali parva utrinque fusco-testaceis; alis hyalinis, margine costali infuscato; clypeo dimidio apicali oblique et subconcave depresso, apice truncato; dimidio basali subporrecto, emarginato, angulis acutis; mesopleuris subtuberculatis; segmento mediano area basali nitida; petíolo longitudine fere duplo longiore; area pygidiali latitudine duplo longiore, lateribus subparallelis; pronoto subemarginato, angulis spina minuta armatis; thorace segmentoque mediano sparse et tenuiter punctatis; capite dense, abdomine sparsius sed crasse punctatis Long. 12 mm.

Hab.—Cairns, Q.

The eyes are divergent towards the clypeus; the small spine at the angles of the slightly emarginate pronotum is remarkable. The mandibles are armed with a very large triangular tooth on the middle of the inner margin.

CERCERIS VICTRIX Turn.

Cerceris victrix Turn., Trans. Ent. Soc. London, 1910, p.422,♀♂, Pl. 1., fig.10,♂.

♀. Aurantiaca; vertice, mesonoto, pleuris, sterno, segmento mediano apice, segmentisque abdominalibus tertio quartoque nigris; alis flavo-hyalinis, apice infuscatis; clypeo in medio bituberculato, dimidio apicali subconcave depresso, margine apicali obtuse quadridentato; mesopleuris vix bituberculatis; segmento mediano area basali nitida; petiolo latitudine fere duplo latiore; ubique crassa punctata; oculis valde divergentibus.

♂. Feminæ similis; clypeo latitudine longiore, subconvexo, apice late rotundato dentibus tribus minutis armato; mesopleuris haud tuberculatis; segmento mediano area basali transverse striato; petiolo longitudine sesqui latiore; scutello nigro, vertice aurantiaco; flagello articulo apicali penultimo haud longiore.

Long. ♀, 16 mm.; ♂, 14 mm.

Hab.—Cairns, Q.

I have not thought it necessary to give a detailed description of this species, the original description being sufficient.

CERCERIS OPPOSITA Sm.

Cerceris opposita Sm., Ann. Mag. Nat. Hist.(4),xii., p.413, 1873,♀.

♀.Nigra; mandibulis basi, clypeo, margine interiore oculorum latissime, carina frontali, macula parva pone oculos, pronoto linea utrinque, tegulis, postscutello macula utrinque, segmentisque dorsalibus secundo, quarto quintoque fascia angusta apicali flavis; femoribus apice, tibiis, tarsis flagelloque subtus ferrugineis; alis subhyalinis; clypeo lamina a medio libera, porrecta, apice truncata; mesopleuris haud dentatis; segmento mediano area basali longitudinaliter striata.

♂.Feminæ similis, clypeo apice late rotundato obtuse bidentato.

Long. ♀, 10 mm.; ♂, 7 mm.

♀.Clypeus with the lamina free from the middle, narrowed to the apex and truncate; antennæ inserted about one-half as far again from the anterior ocellus as from the base of the clypeus, second joint of flagellum scarcely longer than the third. Pronotum rounded at the anterior angles; mesopleuræ without tubercles; first abdominal segment more than twice as broad as long; pygidial area narrow, twice as broad at the base as at the apex, gradually narrowed, nearly three times as long as the greatest breadth. Closely and rather coarsely punctured; the enclosed area at the base of the median segment longitudinally striated. Petiole of the second cubital cell very short.

♂.Clypeus convex, broader than long, broadly rounded at the apex, with two small blunt teeth; pygidial area as broad at the base as long, narrowed towards the apex.

Hab.—Victoria: Melbourne(French).

The male is from Melbourne; the female apparently from Bakewell's Collection.

CERCERIS GILESI Turn.

Cerceris gilesi Turn., Proc. Zool. Soc. 1910, p.346,♀♂, Pl. xxxii., fig.13.

♀.Nigra; mandibulis, clypeo, fronte, scapo, macula parva pone oculos, pronoto, tegulis, scutello, postscutello, pedibus, segmentis, abdominalibus primo secundoque, segmentoque dorsali quinto rufo-aurantiacis; clypeo angulariter emarginato, subporrecto; mesopleuris haud tuberculatis; segmento mediano area basali delicatissime punctata in angulis striata; petiolo longitudine fere duplo latiore; alis hyalinis, cellula radiali infuscata.

♂.Feminæ similis; clypeo latitudine longiore, apice late rotundato, dentibus tribus minutis armato.

Long. ♀♂, 11 mm.

♀♂.Closely and coarsely punctured, more sparsely on the abdomen of the female; pygidial area of the female subovate, elongate, truncate at the extremities, as broad at the apex as at the base.

Hab.—Claremont, W.A.

CERCERIS EUCHROMA Turn.

Cerceris euchroma Turn., Trans Ent. Soc. London, 1910, p.424,♀, Pl. l., fig.11.

♀.Flavo-aurantiaca; mandibulis apice, vertice macula flava utrinque, mesonoto, sterno, segmento mediano fascia curvata aurantiaca utrinque, segmentis dorsalibus primo, secundo dimidio apicali, quartoque, segmentoque ventrali quarto nigris; alis hyalinis, apice et cellula radiali infuscatis, stigmate testaceo; clypeo inciso, subporrecto, angulis obtuse productis; mesopleuris tumidis, haud tuberculatis; petiolo longitudine multo latiore; haud crasse punctata; segmento mediano area basali nitida; abdomine nitido, impunctato; pleuris striatis. Long. 11 mm.

Hab.—Cairns, Q.

The eyes are strongly divergent towards the clypeus.

CERCERIS MULTIGUTTATA Turn.

Cerceris multiguttata Turn., Proc. Zool. Soc. 1908, p.471,♀♂.

♀.Nigra; mandibulis basi, fronte, scapo apice, margine exteriore oculorum, vertice linea obliqua utrinque, pronoto scutelloque utrinque, postscutello, mesopleuris macula, segmento mediano macula magna apicali utrinque, area cordata macula utrinque, petiolo, segmento dorsali secundo dimidio apicali, ventralis toto, quarto, quinto, sextoque flavo-ochraceis, pedibus fusco-testaceis, flavo-variegatis; clypeo ante apicem late porrecto, vix emarginato, apice quadridentato; mesopleuris haud tuberculatis; segmento mediano area basali nitida; petiolo longitudine multo latiore; area pygidiali latitudine duplo latiore, apice rotundato; alis subhyalinis, margine costali infuscato; dense haud crasse punctata.

♂.Feminæ similis; clypeo subconvexo, latitudine haud latiore, apice truncato; petiolo latitudine sesqui longiore.

Long. ♀, 14 mm.; ♂, 9 mm.

Hab.—Mackay to Cairns, Q.

CERCERIS AUSTRALIS Sauss.

Cerceris australis Sauss., Mém. Soc. Physiq. Genève, xiv., p.6, 1855; *Cerceris nigrocincta* Sm., Cat. Hym. B.M., iv., p.450, 1856.

♀.Nigra; mandibulis, apice excepto, clypeo, margine interiore oculorum latissime, carina frontali, macula pone oculos, pronoto utrinque, scutello macula utrinque, postscutello flavis; antennis subtus, pedibus, segmento abdominali secundo, segmentisque dorsalibus 4-6 fulvo-testaceis; segmento mediano interdum macula flava utrinque; alis hyalinis, cellula radiali obscurata, clypeo apice subporrecto, margine apicali truncato in medio dentibus binis minutis armato; mesopleuris haud tuberculatis; segmento mediano area basali delicatissime punctata, in angulis striata; area pygidiali elongato-ovata; petiolo subquadrato, apice constricto.

♂.Feminæ similis; clypeo latitudine longiore; petiolo latitudine sesqui longiore.

Long. ♀, 13 mm.; ♂, 9 mm.

♀. Vertex, thorax and median segment closely and rather strongly punctured, abdomen very finely and sparsely punctured. Antennæ inserted less than one-half as far again from the anterior ocellus as from the base of the clypeus, second joint of flagellum distinctly longer than the third.

♂.Abdomen as strongly and closely punctured as the head and thorax.

Hab.—New South Wales, Victoria, Queensland as far north as Mackay.

CERCERIS INEXPECTATA Turn.

Cerceris inexpectata Turn., Proc. Zool. Soc. 1908, p.469, Pl.xxvi., fig.5, ♀.

♀. Nigra; mandibulis, clypeo, fronte, postscutello, segmento mediano macula magna utrinque, petiolo utrinque, segmentisque abdominalibus secundo quintoque macula basali nigra, flavis; antennis, vertice, margine exteriore oculorum, mesonoto postice, pronoto utrinque, scutello pedibusque sordide ferrugineis; clypeo apice late truncato, subconvexo; segmento mediano area basali subnitida, impunctata; mesopleuris tumidis, subtuberculatis; petiolo longitudine paullo latiore; alis subhyalinis, apice infuscatis.

♂. Clypeo latitudine multo longiore, apice subemarginato; segmento mediano area basali in angulis striata; petiolo latitudine sesqui longiore, mesopleuris haud subtuberculatis; vertice nigro, linea obliqua utrinque flava, genis, scutello, segmentisque abdominalibus 4-6 fascia apicali flava, mesonoto nigro, segmento secundo abdominali dimidio apicali tertioque fere toto sordide ferrugineis.

♀. Deeply but not very closely punctured, more closely on the third and fourth dorsal segments and on the mesopleuræ than elsewhere; pygidial area gradually narrowed from the base, more than twice as broad at the base as at the apex, about twice as long as the greatest breadth, the surface granulate. Mandibles with a broad triangular tooth on the middle of the inner margin.

Hab.—Mackay, Q.

CERCERIS VENUSTA Sm.

Cerceris venusta Sm., Ann. Mag. Nat. Hist.(4), xii, p.413, 1873, ♀.

♀. Nigra; mandibulis, clypeo, fronte, scapo subtus, margine exteriore oculorum, vertice linea obliqua utrinque, pronoto, tegulis, scutello, postscutello, segmento mediano utrinque, segmentis abdominalibus primo, secundo, quarto, quintoque, flavis; segmento primo basi nigro; secundo in medio rufo-testaceo, pedibus testaceis, flavo-variegatis, flagello subtus testaceo; alis hyalinis, cellula radiali infuscata; clypeo apice porrecto, emarginato, angulis obtuse dentatis; mesopleuris haud tuberculatis;

segmento mediano area basali opaca, in angulis striata; petiolo subquadrato, apice constricto; area pygidiali elongato-ovata, apice truncata.

♂.Feminæ similis; clypeo convexo, apice truncato, dentibus tribus minutis armato; petiolo latitudine longiore.

Long. ♀, 11 mm.; ♂, 10 mm.

♀.Antennæ inserted about one-half as far again from the anterior ocellus as from the base of the clypeus; second joint of flagellum a little longer than the third. Clypeus with two minute tubercles close to the middle of the apical emargination. The whole insect closely but not very coarsely punctured.

Hab.—Mackay to Cairns, Q.

This species is very variable in colour. Specimens from Cairns have the yellow markings much reduced and of a duller colour; the minute tubercles on the emargination of the clypeus are also distinctly further apart. It is one of the commonest species in North Queensland.

CERCERIS SÆVA Sm.

Cerceris sæva Sm., Ann. Mag. Nat. Hist.(4), xii., p.414, 1873,♀.

♀.Nigra; mandibulis, apice excepto, clypeo, margine interiore oculorum latissime, carina frontali, tegulis, segmento secundo dorsali macula basali utrinque, quarto dimidio apicali, quintoque fascia angusta apicali flavis; flagello subtus, segmento dorsali secundo lateribus, femoribus apice, tibiis tarsisque fusco-testaceis; alis hyalinis, cellula radiali obscurata, clypeo apice subporrecto, margine apicali late subemarginato; mesopleuris haud tuberculatis; segmento mediano area basali delicatissime punctata in angulis et in sulco mediano striata; petiolo subquadrato; area pygidiali ovata.

♂.Feminæ similis; clypeo latitudine longiore, apice dentibus tribus minutis armato; petiolo latitudine longiore; pronoto utrinque flavo-maculato, segmento dorsali secundo fascia basali flava.

Long. ♂♀, 8 mm.

♀.Closely and coarsely punctured, fourth and fifth abdominal segments more sparsely and finely punctured than the basal ones.

Antennæ inserted about one-half as far again from the anterior ocellus as from the base of the clypeus, third joint of flagellum as long as the second.

Hab.—Lower Plenty, Victoria.

CERCERIS LABECULATA Turn.

Cerceris labeculata Turn., Proc. Zool. Soc. 1908, p.470,♂♀.

♀.Nigra; mandibulis basi, clypeo macula nigra basali, margine interiore oculorum latissime, carina frontali, scapoque flavis; pronoto, scutello utrinque, postscutello, segmentisque abdominalibus primo, secundo, quartoque fascia angusta apicali flavo-ochraceis; scutello, petiolo, segmento dorsali secundo partim, quinto dimidio apicali, sextoque sordida ferrugineis; pedibus testaceis; alis subhyalinis, margine costali infuscata, clypeo apice porrecto, inciso, angulis subtuberculatis; mesopleuris haud tuberculatis; segmento mediano area basali oblique striata; petiolo longitudine multo latiore; area pygidiali angusta, elongato-ovata; ubique dense nec crasse punctata.

♂.Feminæ similis; clypeo convexo, apice late rotundato, haud porrecto; petiolo latitudine longiore, apice constricto.

Long. ♀, 9 mm.; ♂, 8 mm.

Hab.—Mackay, Q.; Cairns, Q.

The clypeus is nearly as long as broad, and slightly narrowed at the apex, much narrower than in *C. minuscula.*

CERCERIS ANTIPODES Sm.

Cerceris antipodes Sm., Cat. Hym. B.M. iv., p.451, 1856,♀.

♀.Nigra; mandibulis, clypeo, fronte, macula parva pone oculos, segmento dorsali quarto dimidio apicali; quintoque macula basali excepto flavis; tegulis, pedibus, petiolo margine apicali, segmento abdominali secundo, quintoque macula basali testaceis; clypeo emarginato, angulis acutis; segmento mediano area basali punctata, in angulis striata; mesopleuris haud tuberculatis; petiolo longitudine paullo latiore; area pygidiali angusta, elongato-ovata; alis sordide hyalinis, nervulis testaceis, cellula radiali infuscata. Long. 10 mm.

♀. Clypeus somewhat narrowed towards the apex, shallowly emarginate, the angles slightly prominent. Antennæ inserted nearly one-half as far again from the anterior ocellus as from the base of the clypeus, third joint of flagellum as long as the second. Very closely and rather coarsely punctured; the basal enclosed area of the median segment very finely punctured, with a few indistinct striæ, the angles more coarsely striated.

Hab.—S.E. Australia: Woodford, N.S.W.

CERCERIS MINUSCULA Turn.

Cerceris minuscula Turn., Proc. Zool. Soc. 1910, p.347, ♂♀.

♀. Nigra; mandibulis basi, clypeo, margine interiore oculorum latissime, scapo subtus, pronoto utrinque, postscutello, segmentisque dorsalibus secundo quintoque apice lateribusque flavis; pedibus testaceis, flavo-variegatis; flagello, tegulisque testaceis; petiolo, segmentis dorsalibus secundo tertioque basi pygidioque fusco-ferrugineis; alis hyalinis, apice infuscatis; clypeo apice libero, angulariter emarginato; mesopleuris haud tuberculatis; segmento mediano area basali delicatissime punctata, striis obscuris transversis; petiolo latitudine æquilongo; area pygidiali elongato-ovata; dense et crasse punctata.

♂. Feminæ similis; clypeo apice late rotundato, tridentato.

Long. ♀, 7-8 mm.; ♂, 6-7 mm.

Hab.—The whole of North-Eastern and Central Australia.

A common species and very variable in colour.

CERCERIS PRÆDURA Turn.

Cerceris prædura Turn., Proc. Zool. Soc. 1908, p.472, ♀.

♀. Nigra; mandibulis, clypeo, fronte, scapo, pronoto utrinque, tegulis, scutello, postscutello, pedibus, segmento dorsali secundo basi, tertio macula basali nigra, quinto, segmentisque ventralibus 1-3 flavis; flagello pygidioque rufo-testaceis; clypeo convexo, late emarginato; mesopleuris haud tuberculatis; segmento mediano area basali punctata; petiolo latitudine longiore; area pygidiali angusta, elongato-ovata; alis hyalinis, apice leviter infuscatis; ubique dense punctata. Long. 7 mm.

Hab.—Mackay, Q.

In this species, there is some trace of a raised area at the base of the second ventral segment, which is, however, so ill-defined and low, that I have not thought it advisable to use it in my key. The petiole is about one-half as long again as broad, in contrast to that of *C. minuscula*, which is subquadrate.

CONTRIBUTIONS TO OUR KNOWLEDGE OF SOIL-FERTILITY.

iv. *The Agricere and Bacteriotoxins of Soil.*

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In the first paper of this series, I showed that, in opposition to Russell and Hutchinson, there were in soils certain toxins which restrained the growth of the soil-bacteria. These were partly or entirely destroyed by heat, by sunlight, and by storage, especially in aqueous solution. Furthermore, I showed that soil contained a fatty or waxy substance, agricere, which was dissolved and carried to the surface of the soil by certain fat-solvents. These solvents are also disinfectants, and this property of destroying vegetating bacteria is probably responsible for obscuring their other property of dissolving fatty bodies.

The research originated in the disbelief of one of the steps which led Russell and Hutchinson to think of protozoa. It was against all bacteriological experience that bacterial toxins should be absent from soil; and it was only by assuming or claiming that no toxins were in soil, that these investigators were led to believe that phagocytic protozoa were responsible for the limitation of the bacterial content of soils.

That the soil-protozoa should play a part in checking the multiplication of bacteria in the soil is very feasible, and many of the experiments recorded by Russell and Hutchinson point to their activity. But it does not follow that the protozoa are alone responsible for the limitation in the numbers of bacteria in soil, as Hall* would lead us to believe. Indeed, Russell and Hutchinson are careful to say that they do not wish to imply that the removal of the large organisms is the only cause of the improvement in soils effected by partial sterilisation. The possibility of other factors was mentioned, and an instance given in a nitrogenous substance very soluble in toluene, the distribution of which would be affected by the toluening. This toluene-soluble substance is so suggestive of agricere, that it is probable that further investigation would show that the claim to its being nitrogenous, has been founded upon insufficient data.

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* Hall, Chem. Soc. Ann. Rep. 1909, 187.

Agricere is presumably derived from the substances "soluble in ether" of plant-roots, stubble, and similar organic matter, which have slowly decayed, and have become incorporated with the soil. The rate of decay of the cellulose and other carbohydrates of the vegetable matter will naturally be more rapid than that of the fatty substance, so that, ultimately, the latter will become concentrated upon the remains of the former, and, by saturating the residual fermentable organic matter, the agricere will act as a preservative. I have referred to this condition as a "waterproofing." By the removal of agricere, the soluble portions of the organic matter will more readily diffuse out, and the soil-bacteria will more readily get into contact with the fermentable fragments of organic matter. From its presumed origin, the agricere should be associated with the organic matter, and should, to a certain extent, be proportional to it. The amount in soils is small, but the quantity of organic matter is, as a rule, also small. The effect of treatment with antiseptics is much as if the crop had received a nitrogenous manuring, which indicates an accelerated decomposition of the organic matter, such as would occur if the agricere were segregated.

I believe that to be the behaviour of the agricere in the soil. With regard to its presence, there can be no doubt, for Schreiner and Shorey* have, simultaneously with me, shown the presence of the glycerides of fatty acids and of paraffin-hydrocarbons in soils. These are the agricere-components which I have referred to as saponifiable and non-saponifiable.

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* Schreiner and Shorey, Journal American Chemical Society, Jan. 1911.

These authors agree with me in considering that the agricere is derived from the remains of the organic matter of plants.

With the removal or segregation of the agricere, the soluble matter will more readily diffuse out from the soil-particles, and as this may be divided into toxic and nutritive substances, the benefit derived from the removal will depend, in the first place, upon the relative preponderance of the one or the other of these. In experiments with soil-extracts, the toxin* generally predominates while, in soils, the nutrients preponderate.

It is difficult to explain the difference between the behaviour of the moist soil and of the extract. A plausible explanation may be found in the relative quantities of water used in the two methods, and in the faint acidity† of the soil. In the soil-tests, the water varied from one-tenth to one-quarter of the weight of the soil, just enough to make it damp; while, in the extracts, an equal weight of water was employed. With the smaller proportion of water, the acidity of the soil would not be so much weakened, and, taken in conjunction with the longer exposure, more of the presumably less soluble nutrients would be dissolved. This reasoning, however, does not appear to hold.

Twenty gr. portions of garden-soil were placed in deep Petri dishes, and to each, 2 cc. of a suspension of *Bac. prodi-*

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* I have used the words "toxin" and "toxins" indiscriminately. Doubtless there are as many varieties of toxin as there are groups of bacteria in the soil. It is known that the toxins of one group may not be toxic to another group, but, so far as these experiments go, *Bac. prodigiosus* behaves to the soil-toxins and nutrients like the ordinary soil-bacteria, and, since its growth is rapid and the colonies easily detected, it acts after the manner of an indicator.

† From the literature upon the subject, one is led to believe that all normal soils are faintly alkaline. Mr. R. S. Symmonds, of the Department of Agriculture, drew my attention to the fact that the majority of soils are acid to litmus, and this holds for the soils I have tested in New South Wales. The method of testing consists in stirring the soil with a small quantity of water, thus forming a paste; and, after from 5 to 10 minutes, pressing a piece of litmus paper upon the mass.

giosus were added, together with varying amounts of water. In 20 hours the following increases were obtained.

EXPERIMENT i.

20 gr. of soil with 2 c.c. of suspension and addition of		10 bacteria became
No water...........	= 10 % added...............	29
3 c.c. of water.. ..	= 25 % added	40
8 c.c. of water.....	= 50 % added	55
18 c.c. of water.....	= 100 % added...............	75

The soil-bacteria were not influenced by the water, as approximately the same number of white colonies developed in all tests in 20 hours.

An attempt to solve the matter was made in another way. An extract of soil was prepared by using 200 c.c. for 500 gr. The extract, however, was toxic; 1,000 bacteria became reduced overnight to 35, while, in a water-control, they increased to 4,050.

Dilution of the soil-extract alters the relation between the toxins and the nutrients, and, in place of having a toxic action, the diluted solution becomes more or less nutritious. This is seen in Experiments iv., and xxiii,

In considering the action of the volatile disinfectants, it is necessary to know if they have any action upon the soil-bacteriotoxins, either destroying or dissolving, and subsequently translating them to other parts of the soil, as in the case of agricere.

The Action of Fat-solvents upon the Soil Bacteriotoxin.—In order to determine if the bacteriotoxin were soluble in fat-solvents, ten experiments were made with chloroform and with ether. The general outcome was that neither of these disinfectants had any solvent action. When the chloroform-extract of soil was evaporated in a current of air, and the waxy residue taken up with warm water, a slight toxic action was noted; but if the residue was treated with warm saline, the solution was found to be slightly more nutritive than a saline control. Traces of chloroform have no pronounced bactericidal action, as will be seen on p.686. Ether behaved like chloroform in dissolving no toxin, and since these two disinfectants have no solvent action, we are probably justified in concluding that other fat-solvents are similarly inactive.

The solvents, furthermore, have apparently no antitoxic or destructive action upon the toxin, if we judge by the behaviour of the soil-extracts after treatment of the soil with chloroform and with ether. Two soils were tested, and the results are shown in the following tables:—

EXPERIMENT ii.

Garden-soil 200 gr. : 200 c.c. : 1 hr.	1,000 bacteria became
Aqueous extract after treatment with chloroform	0
The same extract heated..................	3,850
Saline extract of the soil-residue from above.......	23
The same heated..............	6,300,000

EXPERIMENT iii.

Hawkesbury soil No.4. 100 gr. : 200 c.c. : 1 hr.	1,000 bacteria became
Aqueous extract after treatment with chloroform	0
Aqueous extract after treatment with ether.	0
Aqueous extract without previous treatment	200
Aqueous control (no soil).........................	7,600

EXPERIMENT iv.

Aqueous extract of soil. Soil No.4.	1,000 bacteria became					
	Bac. prodigiosus.				Soil-bacteria.	
	Ratio = 100 gr. : 200 c.c. : 1 hr.				200gr. : 200c.c. : 1hr	
	diluted 1/2.		diluted 1/4.		undiluted.	
	unboiled	boiled	unboiled	boiled	unboiled	boiled
After treatment with chloroform	0	642,000	1,000	207,000	930	20,270
After treatment with ether	0	174,000	700	532,000	... ...	......
Untreated..........	0	568,000	2,180	495,000	1,200	15,510
Aqueous control...	5,100		5,600		1,100	

From these experiments, it is evident that the soil-bacteriotoxin is not destroyed, and is probably unaffected by chloroform or ether. As it is not dissolved by these solvents, it follows that the numerical increase, which follows the treatment of the soil with these disinfectants, is not caused by any alteration in the bacteriotoxin already present in the soil.

The Effect of Reaction of the Medium upon the Toxic Action of Soil-Extracts.—Two sets of experiments, with gradually increasing amounts of lactic acid and of sodium carbonate, showed that a neutral or faintly acid solution favoured the growth of *Bac. prodigiosus* in filtered soil-extracts, but that the reaction had no influence upon the toxin, was shown by the control-experiments in which no toxin was contained, behaving in a precisely similar manner.

The Soil-Bacteriotoxin is not Volatile.—Beyond the fact that the soil-bacteriotoxin is toxic to bacteria, is thermolabile, is destroyed by sunlight, and is insoluble in chloroform and ether, we know little about it. It appears to be non-volatile, for when air-dried soil was heated at 75° C. in a slow current of air under diminished pressure, the few drops of condensed water that were collected possessed no toxic properties.

Action of Rain.—In the soil, the bacterial growth is weakened by the toxin and strengthened by the soil-nutrients, and the fertility, so far as these factors are concerned, will depend upon the equilibrium established between the two. One of the effects of rain is to dissolve the toxin, and carry it into the subsoil, where it may decay after the manner of the toxin in filtered extracts. The Hawkesbury soil, No. 4, was undoubtedly less toxic after heavy rains in January, 1911, than it was in October, 1910, and the earlier part of the same year.

This observation led to an experiment being tried to test the distribution of the toxin after moistening the soil with water, similar to what would occur with a heavy shower of rain. A kilogram of soil was placed in a wide glass jar (the bottom of a moist chamber), and, in this, the soil showed a depth of two inches. The soil was then thoroughly wetted by sprinkling from above with distilled water, and allowed to dry in the air. The top half was separated from the lower, and both portions were exposed to the air for a day. Suspensions of *Bac. prodigiosus* were added to the soil and to its extract, as in previous experiments.

EXPERIMENT V.

—	1,000 bacteria became		
	Hawkesbury No.4.		Garden-soil.
	Soil.	Extract.	
Top soil....................	3,600	520	2,900
Bottom soil	3,000	123	2,000

The greater toxic power of the bottom soil appears to show that the toxin is carried down by the water percolating from above.

Treatment of the Soil with Non-Volatile Disinfectants.—If the action of the volatile disinfectants is solely to kill phagocytic protozoa, the non-volatile disinfectants should behave in a precisely similar manner, while the fatty bodies in the soil should be unaffected. To test if this reasoning was good, portions of a soil were treated with solutions of 5 % phenol, 0·1 % mercuric chloride, 1 % potassium bichromate, and 1 % copper sulphate, for a day. They were then washed and dried. A portion of each was treated with chloroform, and compared with the untreated portion. Unfortunately all the portions were toxic, and the whole of the added bacteria were killed off. Evidently the non-volatile disinfectant adheres tenaciously to the soil-particles, and resists removal by a moderate quantity of water. Upon again moistening the soil, the residual disinfectant is dissolved, and checks bacterial growth. Potassium permanganate was not toxic, but the soil-particles had apparently become covered with the reduced salt, as it became very absorbent; there was no difference between the treated and the untreated portions.

The Action of Chloroform-Water upon the Growth of Bacteria in Soil.—As a rule, substances that are toxic in comparatively large doses, are generally stimulative in comparatively small quantities, and it is just possible that traces of the volatile disinfectant adhere to the soil-particles, and stimulate the growth of bacteria. It had been shown, in a preliminary experiment, that small quantities of chloroform did not prohibit the growth of bacteria, and an experiment was made to see if there could be any stimulation. Several 20 gr. portions of soil were put into bottles, and mixtures of chloroform-water and sterile tap-water in varying proportions were added, along with a suspension of *Bac. prodigiosus*. The total quantity of fluid added was 12 c.c. to each bottle. The tests were incubated overnight at 30°, and, on the following day, dilutions were made, and the number of bacteria determined.

EXPERIMENT vi.

Soil with chloroform-water.	10 cells of *Bac. prodigiosus* became	Rough relative analyses of the other colonies upon the plates.			
		Fluorescent colonies.	Flat, dry colonies.	Moist, raised colonies.	Small colonies.
66%	4	1	22	1	8
50%	8	2	15	3	15
33%	29	9	16	2	43
16·7%	42	0	12	1	100
None	84	0	15	1	38*
”	none added	3	12	2	148

So far as *Bac. prodigiosus* is concerned, it is seen that chloroform-water restrains the growth, but that a multiplication occurs in the presence of one part of chloroform-water and two parts of tap-water (33 %).' There is, however, no evidence of any stimulating influence of the volatile disinfectant.

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* The increased growth of *Bac. prodigiosus* had checked these bacteria.

The Search for an Antitoxin.—The knowledge of the existence of a toxin in the soil naturally leads to the desire to find an antitoxin or substance which, when applied after the manner of a fertiliser, will favour the growth of bacteria by neutralising the toxin. Practically this must be cheap, and easy of application. So far as economy is concerned, we have seen that exposure to the sun's rays diminishes the toxicity, and doubtless the benefits that accrue from working the soil are, in part, traceable to this fact. It is possible that this, together with the natural decay, is the only economic method of combating the accumulation of the toxic products of bacteria.

But an enhanced fertility has been obtained, in certain cases, by the use of substances which are not generally considered as fertilisers, inasmuch as they do not contain the customary nitrogen, phosphoric acid, potash or other constituent taken up by the plant in quantity. For example, ferrous sulphate and manganese sulphate have been used as manures, in some cases with advantage to the crop; copper salts also, when used as fungicides, have generally a distinct action in increasing the growth of plants. It is possible that these may act indirectly as toxin-destroyers.

To ascertain the action of saline substances as antitoxins, two methods might be employed in the laboratory. They might be added to the soil itself, or to an extract. In the latter case, the antitoxic action would probably be more pronounced, for the reason that the toxic action is more prominent. Both methods were tried, and the substances that were tested were copper sulphate, copper sulphate followed by lime-water, manganese sulphate, ferrous sulphate, ferric chloride, sodium phosphate, ferrous sulphate and lime-water with air blown through until all the iron had been oxidised, aluminium sulphate, superphosphate, sodium sulphite, sulphuretted hydrogen, and sodium thiosulphate. Some of these, as copper sulphate, were themselves toxic, while the others, as superphosphate, simply acted as stimulants after the manner of magnesium and potassium sulphates, as already noted. The only salt that gave any promise of possessing any degree of antitoxic power, was sodium thiosulphate, and it was further investigated. The following four experiments are given as showing the general result in solutions of the extract, and in the soils themselves.

EXPERIMENT vii.

—	1,000 bacteria became	
	No thiosulphate.	Thiosulphate, 0·017%.
Dilute extract of stored garden-soil	23,000	108,000
Dilute extract of Hawkesbury soil No. 4	1,000	1,143,000
Water-control	1,400	10,000

EXPERIMENT viii.

—	1,000 bacteria became
Extract of soil No. 4	50
Extract of soil No. 4, boiled	3,700
Extract of soil No. 4 with thiosulphate, 0·17%.	5,600,000
Water-control	14,000

EXPERIMENT ix.

20 gr. soil + 2 c.c. suspension + 2 c.c. 0·5% thiosulphate or water.	1,000 bacteria became	
	Water.	Thiosulphate.
Hawkesbury soil No. 4	40	105
" " "	60	109
Stored orchard-soil	10	48
Stored garden-soil	21	32
Sand	13,900	19,200

EXPERIMENT X.

20 gr. soil + 1 c.c. suspension + 1 c.c. thiosulphate or water.	Thiosulphate, %, in water added.	1,000 bacteria became
Hawkesbury soil No. 4	0	3,100
„ „ „	0	2,800
„ „ „	0·01	2,950
„ „ „	0·05	4,750
„ „ „	0·1	5,500
„ „ „	0·2	5,450
Sand	0	130,000
„	0·2	540,000

Although the results obtained with the extracts (Experiments vii. and viii.), especially of the Hawkesbury soil, raised the hope that some neutralisation of the toxin had occurred, yet the findings with the soils themselves (Experiments ix. and x.) indicate that the bacterial increase was, in all probability, caused by the stimulation of the salt. The toxin is probably unaffected.

The Action of Heat and of Fat-Solvent upon Soils.—In endeavouring to demonstrate the action of fat-solvents in removing the agricere from soils, it is necessary to eliminate any disturbance produced by the bacteriotoxins and by protozoa.* This would appear to be a simple matter, since both of these are destroyed by heat. Unfortunately, as the natural toxins are destroyed, the heat-toxins of Pickering are developed, and a soil which has been heated for some time, becomes exceedingly toxic. This will appear evident from the consideration of the following experiments. In the tables, I have calculated the increase from 10 original cells of *Bac. prodigiosus*, the micro-organism used in the experiments, which were made in the manner already described*; 20 grms. of soil being moistened with 2 c.c. of suspension. The soils were heated at 100°-105° C.

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* When a soil has been air-dried and stored in that condition for any length of time, it is exceedingly probable that the phagocytic protozoa will have been destroyed, or so weakened that they will be unable to become sufficiently active to exercise their phagocytic functions within the time, viz., 20 hours, occupied in the experiments. But on account of the uncertainty of their being really inactive, means had to be adopted to ensure their inertness.

EXPERIMENT xi.

Hawkesbury soil No.4 stored 2 months.	10 bacteria became	
	Untreated.	Treated with chloroform.
Not heated	51	307
Heated 1 hour	115	108
Heated 2 hours	97	12
Heated 4 hours	3	8
Heated 6 hours	0·3	0

EXPERIMENT xii.

Garden-soil.	10 bacteria became	
	Untreated.	Treated with chloroform.
Not heated	75	1,850
Heated 1 hour	10,900	4,170
Heated 2 hours	18,700	6,250
Heated 4 hours	3,020	[75]

EXPERIMENT xiii.

Good arable soil stored 9 days.	10 bacteria became	
	Untreated.	Treated with chloroform.
Not heated	15	785
Heated 1 hour	43	80
Heated 2 hours	16	1
Heated 4 hours	0	0

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* These Proceedings, 1910, p.818.

These experiments indicate (and the experimental error being considerable, one cannot consider them other than as an indication) that the action of heat and of chloroform is complex. There is a destruction of a natural toxin and the production of a heat-toxin in both the untreated and treated sets. In the chloroformed sets, the action of the natural toxin is masked by the greater diffusion of the nutrients and of the heat-toxins. The latter apparently diffuse more easily out of the particles of treated than out of the untreated soils.

Taken as a whole, the experiments show that the fat-solvent has a pronounced action in liberating the nutrients of unheated soil, and in liberating the toxins of heated soils. The continued action of heat is to destroy the natural toxin, and to produce more and more heat-toxin.

The action of carbon bisulphide is different from that of chloroform, inasmuch as the heat-toxin is either not so diffusible, or it is largely destroyed. This will be seen from the following. As we have no reason for believing that the heat-toxin can be less diffusible, we may conclude that it is more or less destroyed. There is a doubt, however, about the purity of the carbon bisulphide; some samples that I obtained were toxic, and it may be that the solvent used in these experiments contained a nutrient.

EXPERIMENT xiv.

Garden-soil.	10 bacteria became			
	a		*b*	
	Untreated.	Treated with carbon bisulphide.	Untreated.	Treated with carbon bisulphide.
Not heated	127	780	22	350
Heated 1 hour........	1,877	3,240	2,720	3,100
Heated 2 hours.......	3,677	6,340	9,000	18,620
Heated 4 hours.......	3,360	7,850	6,630	[160]

EXPERIMENT XV.

Hawkesbury soil No. 4 stored 2 months.	10 bacteria became	
	Untreated.	Treated with carbon bisulphide
Not heated.	71	550
Heated 1 hour at 105°............	140	440
Heated 2 hours at 105°............	5	130
Heated 4 hours at 105°............	7	21

In the experiments which have been recorded, the development of the heat-toxins and their solubility in water prevented the action of the agricere being clearly shown. Accordingly, another method of endeavouring to demonstrate the solvent action of the disinfectants upon the agricere was adopted. This had for its principle the pasteurisation of the soil. It is exceedingly unlikely* that the protozoa can survive exposure to a moist heat at 75° C., for 10 minutes, and, in view of the previous experiments, that any appreciable amount of heat-toxin will be developed.

A garden-soil was moistened with water, and heated in the water-oven. In two hours, the temperature of the soil, as recorded by a thermometer with its bulb in the middle of the soil, reached 75°, and 10 minutes later it had risen to 78°. The dried layer of soil on the top was rejected, and the lower moist soil was spread out upon a sheet of glass, and allowed to cool and dry in the air. Portions weighing 20 gr. were taken, and tested with and without previous treatment with ether (Merck).

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* Russell and Golding, Journ. Soc. Chem. Ind. xxx. 1911, p.741, say that the protozoa are completely destroyed at 60°.

EXPERIMENT XVI.

	10 bacteria became
Pasteurised soil	255
Pasteurised soil treated with ether	1,190

As there could be no phagocytes present in the pasteurised soil, and since it has been shown (pp. 682-684) that ether has no action upon the soil-toxin, the increased growth from the ether-treatment can be ascribed only to the increased solubility of the nutrients, resulting from the segregation of the agricere.

The action of the fat-solvent was again tested upon two soils, which had been obtained from the Hawkesbury Agricultural College. They were designated "good" and "medium." After being moistened with water, they were heated in an air-oven, as in the previous experiment. The temperatures in the middle of the soils reached 75° in an hour, and was 79° ten minutes later. The top layers were rejected, and the soils were spread out to cool and dry.

EXPERIMENT XVII.

	10 bacteria became	Soil-bacteria in 0·0001 gr. of test soil after 3 days at 28°
Good soil untreated	32	—
Good soil pasteurised	580	59
Good soil pasteurised and treated with chloroform	8,015	102
Medium soil untreated	52	—
Medium soil pasteurised	185	20
Medium soil pasteurised and treated with chloroform	31,750	53

With regard to the soil-bacteria, 20 gr. portions of the soils were, after treatment, moistened with sterile water, and incubated at 28° for three or four days. The numbers represent the colonies that grew upon plates seeded with the suspension from 0·0001 gr. of soil. With a short incubation period, one cannot expect to get true comparative results when there is a difference in the treatment of the soil-tests. The above result is probably exceptional, and chanced to agree with the tests made with *Bac. prodigiosus*. A soil which has been pasteurised and treated with chloroform should contain fewer bacteria than a soil which has only been pasteurised; the double treatment should further reduce the number of bacteria. Thus, at the time when the soil is moistened, there should be a greater number of micro-organisms in the pasteurised than in the pasteurised and chloroformed soil. This will give the former a favourable start, and a considerable time, weeks perhaps instead of days, will elapse before the effect of the soil-treatment can really be seen. For this reason, the experiments with *Bac. prodigiosus* are to be preferred, as indicating the true response of the soils to the various methods of treatment.

After noting that Russell and Golding had said that the phagocyctic protozoa are completely destroyed at 60°, the air-dried soils were heated at 65°-68° for 10 minutes, and tested as in the previous experiment.

EXPERIMENT XVIII.

	10 bacteria became	
	Garden-soil.	"Good" soil.
Untreated...........................	242	248
Heated at 65°	1,700	520
Heated at 65° and chloroformed...	9,880	2,440

Further sets of experiments were made with the idea of testing the various solvents, and the results confirmed those previously obtained.

EXPERIMENT xix.

Pasteurised garden-soil.	Bacteria in 0·0001 gr. of soil.		*B. prodigiosus*; 10 bacteria became
	a (8 days.)	*b* (5 days.)	
Not treated......	1,280	67	1,700
Not treated	1,300	58	—
Treated with carbon bisulphide	1,340	—	—
Treated with chloroform.......	1,690	1 020	9,880
Treated with chloroform vapour.....	1,540	920	—
Treated with toluene......	—	120	3,160
Treated with ether...	—	300	4,900
Soil (not pasteurised)......	—	40	—

The general result of these experiments with pasteurised soil, is to show that, in the absence of any possible action of protozoa, etc., the solvent has a decided and considerable action of its own in enabling the bacteria to grow. As the solvent has no action upon the toxin, this can only be brought about by the nutrients being made more available, and is a very strong argument in favour of the idea that the segregation of the agricere is the chief action of the solvents or volatile disinfectants.

The Distribution of the Agricere in the Soil, after Treatment with Solvents.—It has already been shown (Experiments iii. and iv.) that soils which have been treated with an antiseptic, yield extracts which are more toxic than those obtained from untreated soils, and that soils give up their heat-toxins more freely after treatment (Experiments xi., xii., xiii.). So far as the extracts are concerned, the quantity of extracting material which has generally been used, viz., 200 c.c. for 200 gr., has ensured a greater diffusion of the toxins than of the nutrients from the soil-particles. In the experiments with heated soils, doubtless the quantity of toxin produced has been so great as to overwhelm the action of the nutrients. Still the fact, that a greater quantity of toxin does diffuse out, shows that the fat-solvent has done something more than kill off phagocytic protozoa. If the treatment with antiseptics facilitates the diffusion of toxins, surely it will also assist the more rapid diffusion of the nutritive matter.

When the disinfectant is added to the soil in quantity sufficient to soak it thoroughly, it is noticed that, as the fat-solvent evaporates, the agricere is partly deposited as a ring upon the containing vessel at the surface of the soil. It is not expected that all the agricere is in the extreme upper layers, any more than that one extraction with solvent would be enough to remove all the fatty matter. As a matter of fact, the soil has to be percolated for some time with solvent in order to remove all the agricere. Upon moistening the soil with chloroform or ether, and allowing the disinfectant to evaporate, the agricere should be chiefly in the upper layers, and the lower strata should be comparatively free from it. Experiment showed that such is the case.

A hundred grams of air-dried soil (No. 1) were placed in a beaker, and soaked with ether (Merck). When the odour had passed off, the layers were carefully abstracted, and weighed (20gr.) portions were moistened with 2 c.c. of a suspension of *Bac. prodigiosus*, and incubated overnight. Next day, the soils were shaken up with water, and dilutions prepared for the bacterial count.

EXPERIMENT XX.

20 gr. of soil at	10 bacteria became
Top	33
Middle	100
Bottom	165

The comparative poverty of the lower layers of the soil in agricere, is shown by the greater increase in the growth of the bacteria.

In another experiment, 500 gr. of a garden-soil were placed in a beaker, and wetted with ether, and the solvent was allowed to evaporate. When all odour had disappeared, the layers were separated into 100 gr. portions. The five layers were tested in the usual manner, by infecting them with a suspension of *Bac. prodigiosus*, and incubating the portions for 20 hours at 28°. Another set was tested by moistening 20 gr. of the soil with 5 c.c. of sterile water, and incubating at 28° for three days. The numbers of the bacteria in the two sets closely follow one another, and, with the exception of the top soil, which is exceptional*, the results agree with the previous experiment.

EXPERIMENT XXI.

	10 cells of *Bac. prodigiosus* in 20 hours became	Bacteria in 0·0001 gr. of soil in 3 days became
Top layer	800	225
Second layer.........	375	155
Middle ,, ...	525	200
Fourth ,, ...	820	350
Bottom ,, ...	890	360

Other experiments, made by simply moistening the soils, confirmed these results. Portions of soil, weighing 100 gr., were placed in beakers, and wetted with chloroform, ether, or carbon bisulphide. When all odour of the solvent had disappeared, 20 gr. portions were removed from the top, middle, and bottom. These were exposed to the air to ensure the volatilisation of the last traces of solvent, and were then moistened with 5 c.c. of water, and incubated at 28° in a moist atmosphere.

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* This exceptional behaviour was confirmed in another experiment with garden-soil, in which 10 cells became 582, 252, and 450 for the top, middle and lower layers respectively. It has also been found in soils exceedingly rich in agricere, *e.g.*, sewage-sick soils, that the top layers are, after treatment, much more nutritive to *Bac. prodigiosus* than the natural spore-forming soil-bacteria which show most growth in the lower layers. The reason for this difference will probably be found to be that, in the rich soils, the action of the toxins is of more moment than the agricere, so far as the growth of the comparatively strong toxin-sensitive *Bac. prodigiosus* is concerned.

EXPERIMENT xxii.

	Bacteria in 0·0001 gr.			
Soil	Good.	No. 1 (old).	Garden.	Garden.
Solvent	Carbon bisulphide.	Ether.	Chloroform.	Chloroform.
Incubation	5 days.	6 days.	6 days.	20 days.
Top layer	26	141	3,420	2,100
Middle layer	39	209	4,440	2,200
Bottom layer	47	244	4,940	2,400

Extracts prepared from the different layers of soil after antiseptic treatment, should contain more toxin in the lower than in the upper strata. This proved to be the case. In the following, the usual method of extraction was adopted—500 gr. of soil were moistened in a beaker with ether, and exposed to the air until all odour had gone; the top 200 gr. and the bottom 200 gr. were each treated with 200 c.c. of tap-water in a mortar. After an hour, the extracts were filtered through paper, and then through porcelain. The extracts were diluted with an equal volume of sterile tap-water, and 10 c.c. portions of full and half strength extract were seeded with 1 c.c. of a suspension of *Bac. prodigiosus*, and incubated overnight.

EXPERIMENT xxiii.

	1,000 bacteria became		Steamed for an hour on four consecutive days.	
Extract of	Full strength.	Half strength.	Full strength.	Half strength.
Top 200 gr.	34	190	25	300,000
Bottom 200 gr.	3	80	0	70
Control (tap water)	187,400		4,200	

The last few experiments show that treatment with fat-solvents brings about an alteration in the soil, whereby the upper layers are less nutritive than the lower, and give up a smaller amount of toxin to an excess of water. The nutritive substances and toxins of the upper layers are less accessible to bacteria, and less easy of extraction than the lower. This is a strong indication that the agricere has been translated upwards by the fat-solvent, and, although deposited in a manner quite diffrent from its original condition, is still able to exhibit, though to a less degree, its power of protecting the soil-particles from attack.

Summary.

Rain washes the soil-toxins into the subsoil.

The volatile disinfectants or fat-solvents have no action upon the soil-toxins.

Traces of volatile disinfectants have no action upon the bacteria under experimental conditions.

Substances capable of acting as antitoxins are at present unknown.

The action of heat upon soil is, first, to destroy the original toxin, and then to produce heat-toxins, the one action running into the other

After treatment with volatile disinfectants, the toxins or heated soils are more easily dissolved by water than the toxins of untreated soils.

Treatment with volatile disinfectants induces an increased growth of bacteria in soils in which the protozoa, etc., have been destroyed by moist or dry heat at 65°-75°.

The upper layers of soils which have been treated by volatile disinfectants are less nutritive to bacteria than the lower. Conversely, more toxin is given up to water.

These results point to one of the chief actions of the volatile disinfectants being to translate the agricere of the soil, and enable the nutrients to be made more available; that is, they act as fat-solvents.

NOTE ON A NEW SPECIES OF *FAVOSITES* FROM YASS DISTRICT, N.S.W.

By A. B. Walkom, B.Sc., Demonstrator in Geology, The University of Sydney.

(Plates xxx.-xxxi.).

Favosites tripora, sp.nov.

Specific Characters.—Corallum compound, massive. Corallite-tubes prismatic and polygonal-quadrangular to heptagonal, but with pentagonal and hexagonal greatly predominating, and all of approximately uniform size. The average diameter of the corallite tubes is 2½-3 mm. The walls are slightly thickened by deposit of secondary material; the primordial wall is very thin. No longitudinal striæ are visible on the walls. The mural pores are of medium size, and have no elevated rim surrounding them. There are usually three rows, sometimes two, alternately placed and about the same vertical distance apart as the tabulæ. Septa are well-developed short spines, 12 in number, regularly placed, and reaching only a short distance in from the wall. They are most frequently ranged on the walls of the corallites, and only occasionally occupy the angles. Tabulæ are numerous and complete, almost straight, and often markedly bent downwards near the walls; occasionally they branch. They are not thickened by secondary material. They are fairly close together, averaging about two to the millimetre; they are usually opposite one another, or nearly so, in adjacent corallites. Old chambers are transversely oblong, with a length of about twice and one-half the height.

Obs.—This species is most closely allied to *F. gotlandica* (Lam.), described from Tamworth by R. Etheridge, Junr.[*] There are, however, differences in several of the specific characters—the corallite tubes are generally larger, the tabulæ are more closely spaced than in *F. gotlandica*, the septa are more regularly arranged and shorter, and the mural pores are generally in three vertical rows.

Most of the corallite tubes are filled with fine, granular calcite, and sometimes partly with fine, crystalline quartz-grains. On account of the type of filling, internal structures are seen much better in weathered specimens than in thin sections.

Locality and Horizon.—Silurian beds of Derrengullen Creek, near Yass.

Two other species of *Favosites*, viz., *F. gotlandica* Lam., and *F. basaltica* Goldfuss, var. *salebrosa* are found in the same beds.

I have to thank Mr. W. S. Dun for much advice and help in connection with the preparation of this note.

EXPLANATION OF PLATES XXX.-XXXI.

Plate xxx.

Fig. 1.—Two specimens of *F. tripora* (× ⅔).

Fig. 2.—Part of weathered surface showing disposition of septal spines and shape of corallites (× 3).

Fig. 3.—Transverse section, showing occasional spinose septa (× 10).

Plate xxxi.

Fig. 1.—Longitudinal section of corallites, showing bending down of tabulæ, short spinose septa, and thickening of walls (× 10).

Fig. 2.—Enlargement of walls showing disposition of mural pores (× 2½).

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[*] R. Etheridge, Jr., "The Corals of the Tamworth District." Records Geol. Surv. N. S. Wales, Vol. vi., p. 151.

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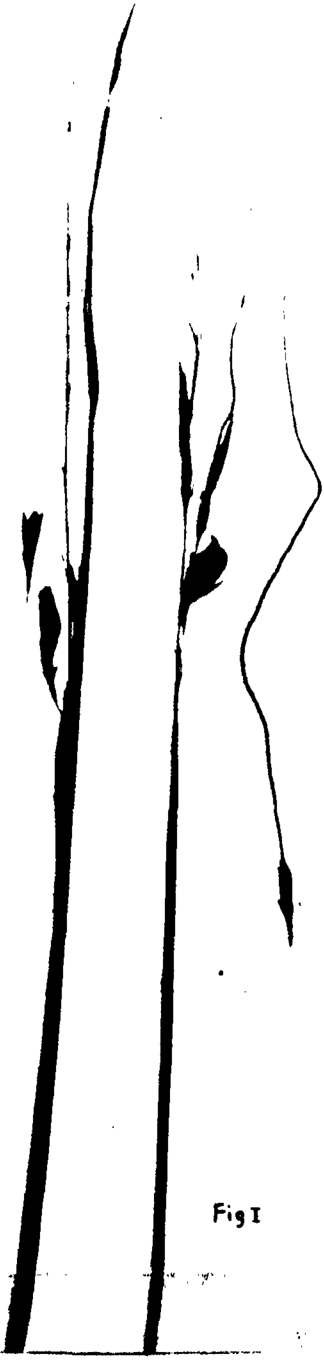


Fig I

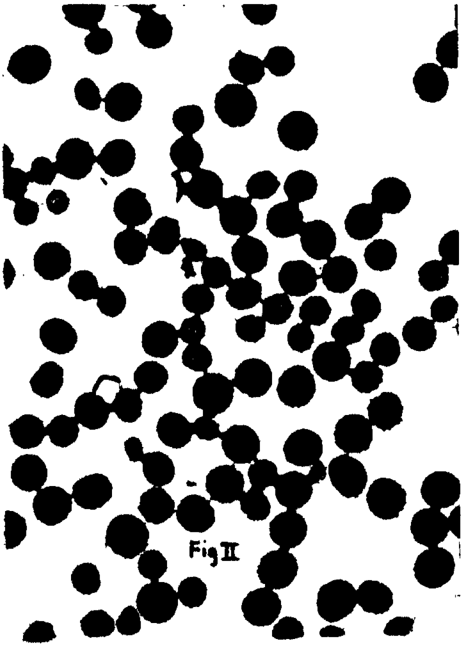


Fig II

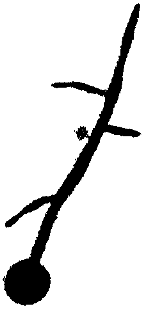


Fig III

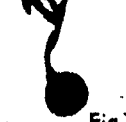
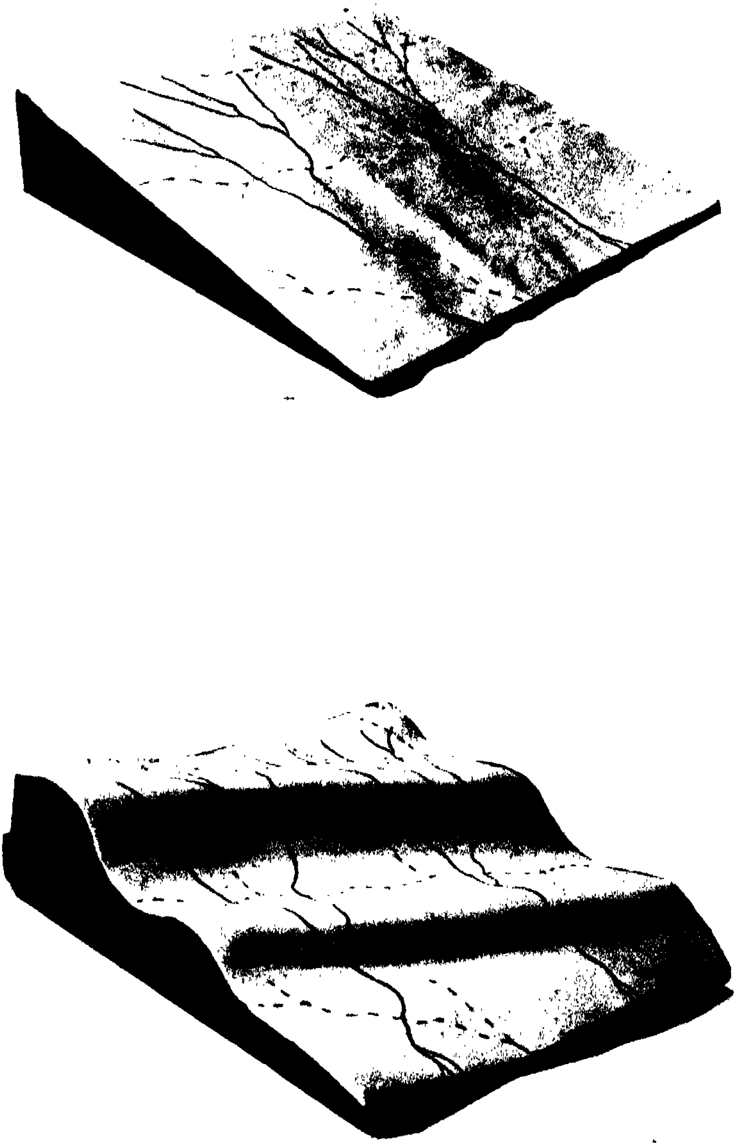
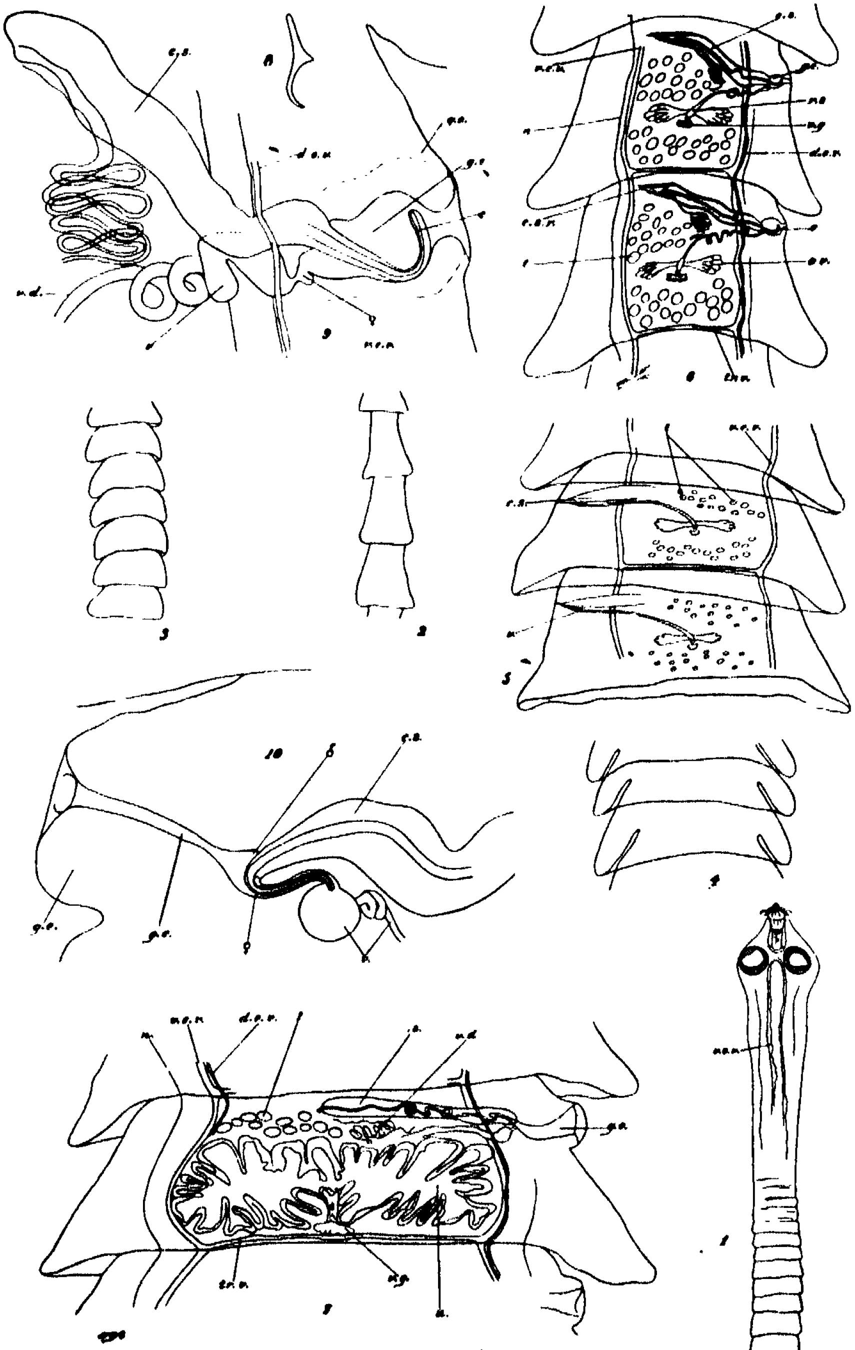


Fig IV

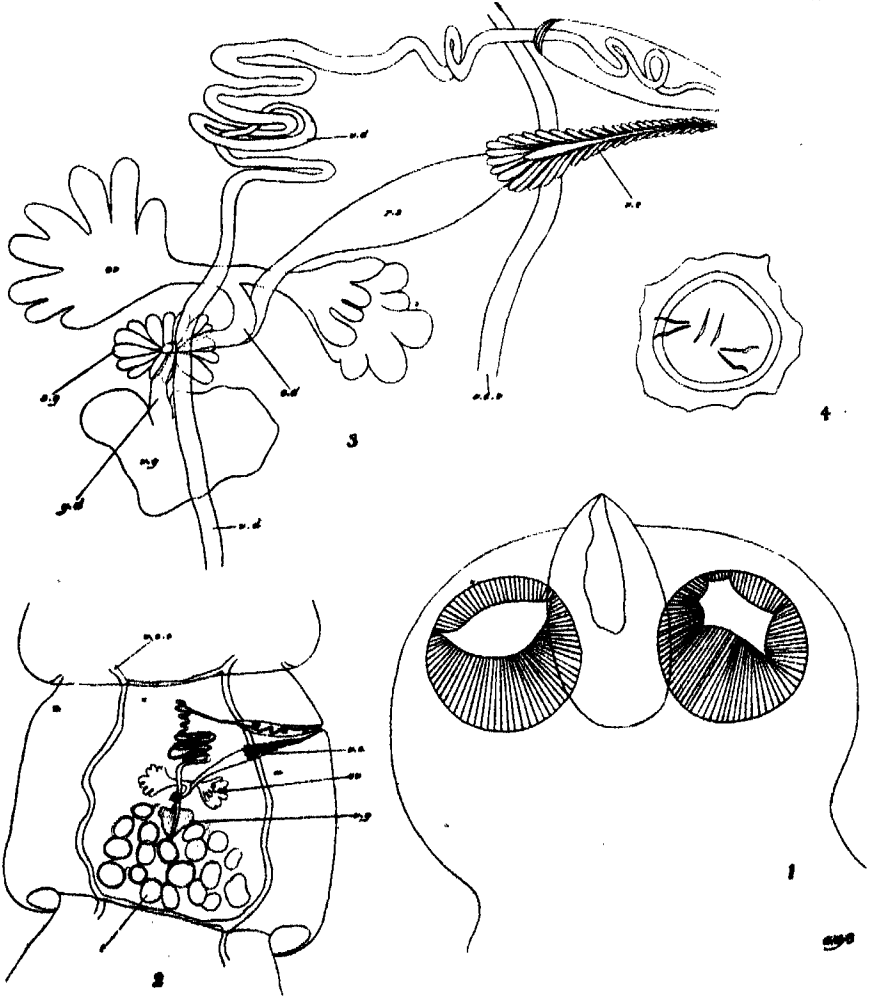
Ustilago ewarti, n. sp.



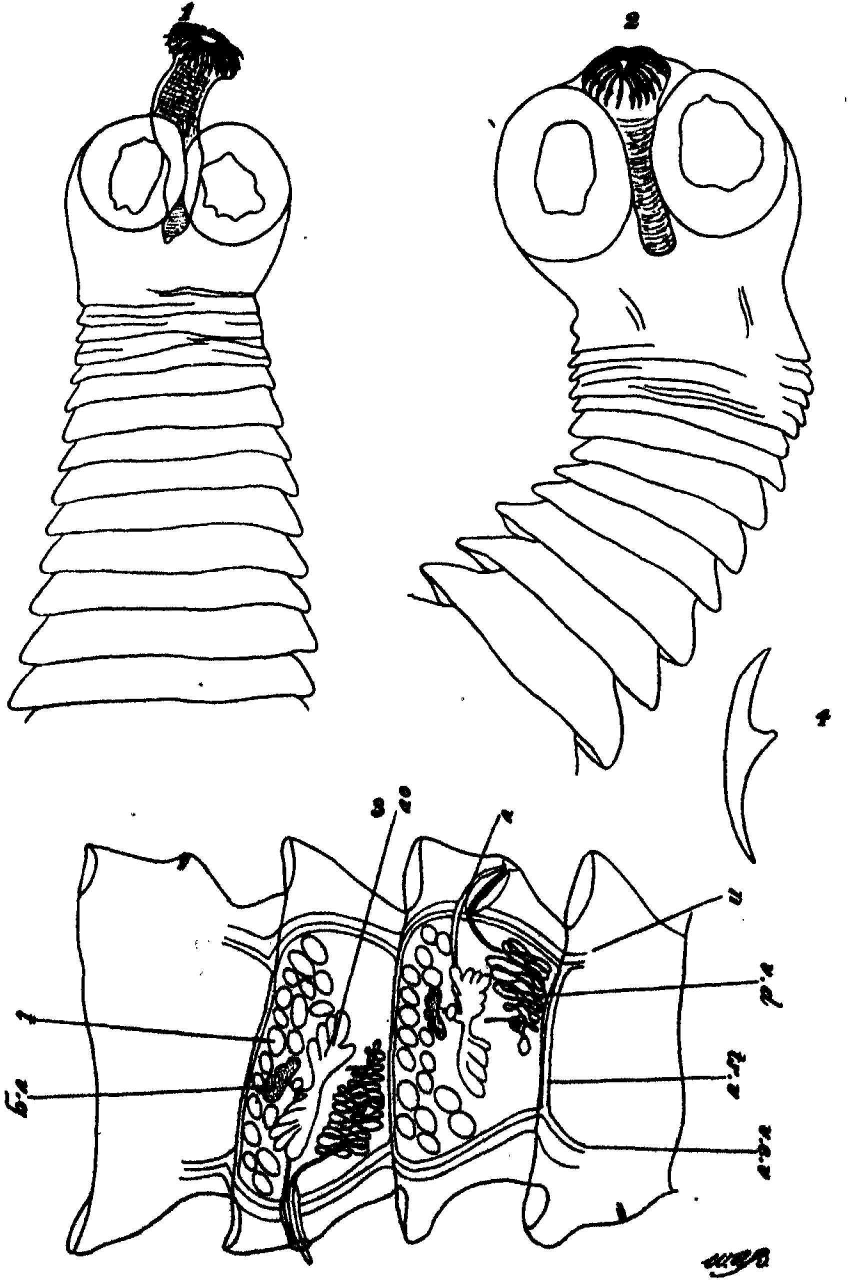
Models illustrating the Transformation of Drainage, from radial to marginal.



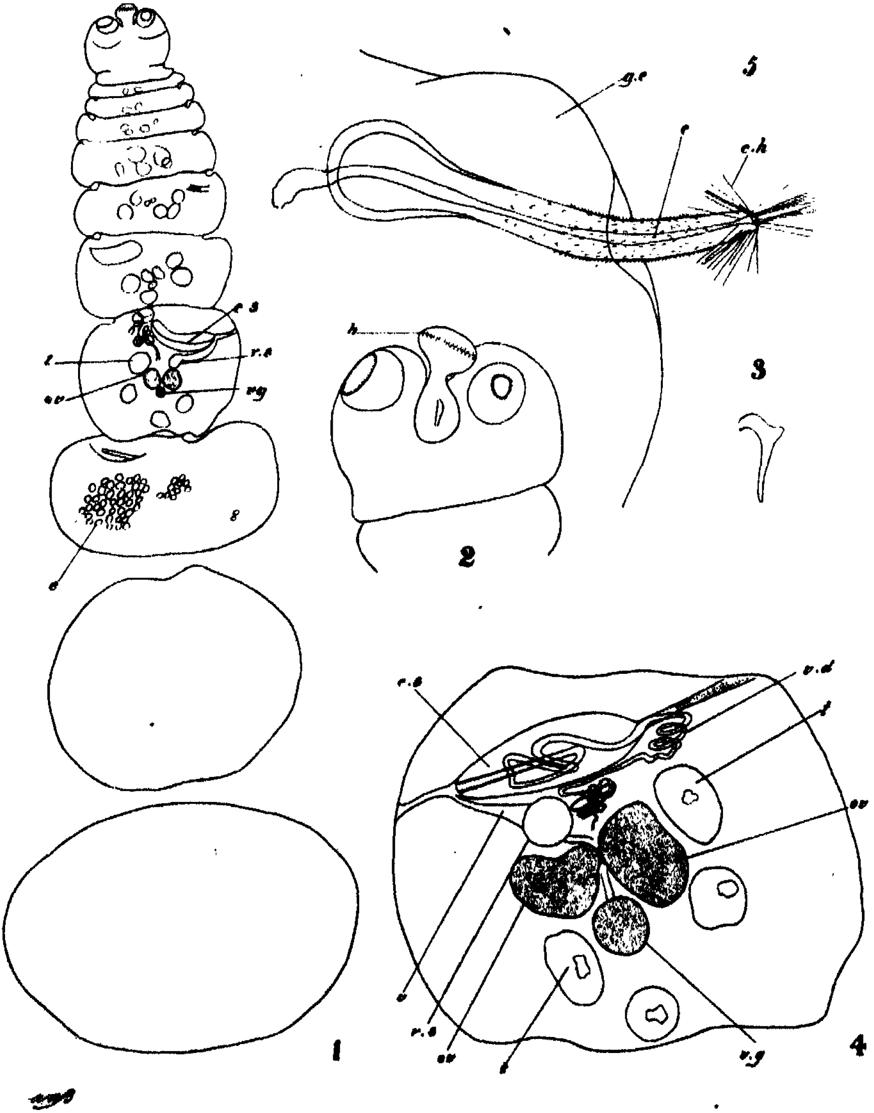
Bancroftiella tenuis, n. sp.



Choanotænia meliphagidarum, n. sp.



Anomotænia rhinocheti, n. sp.



Davainea himantopodis, n. sp.

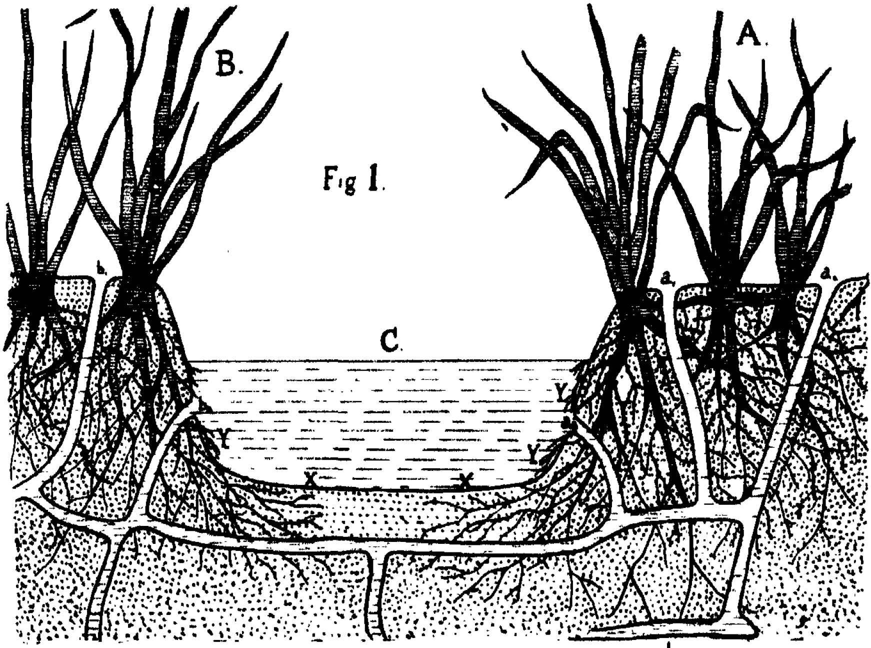


Fig 1.

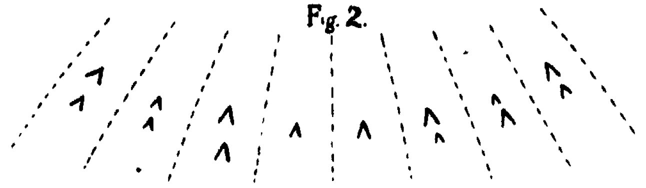


Fig. 2.

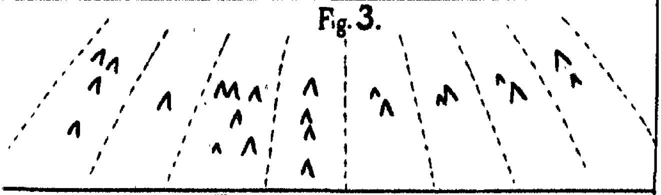


Fig. 3.

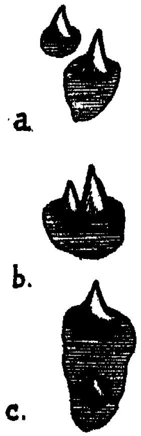


Fig. 4.

Fig. 5.

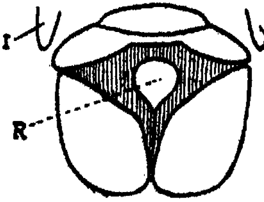
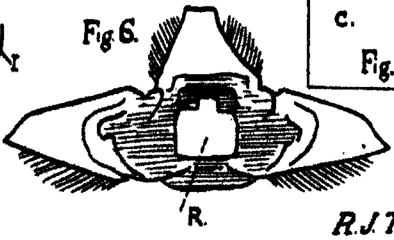


Fig 6.



R.J.T. del.

Life-history and Larval Structure of *Petalura gigantea* Leach

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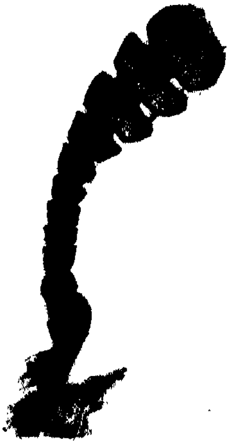

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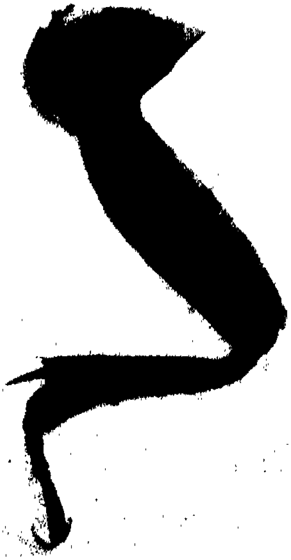

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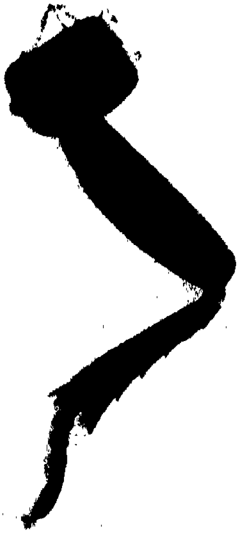

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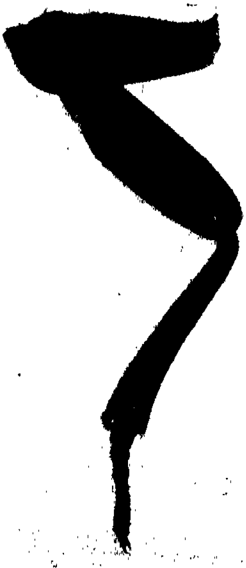

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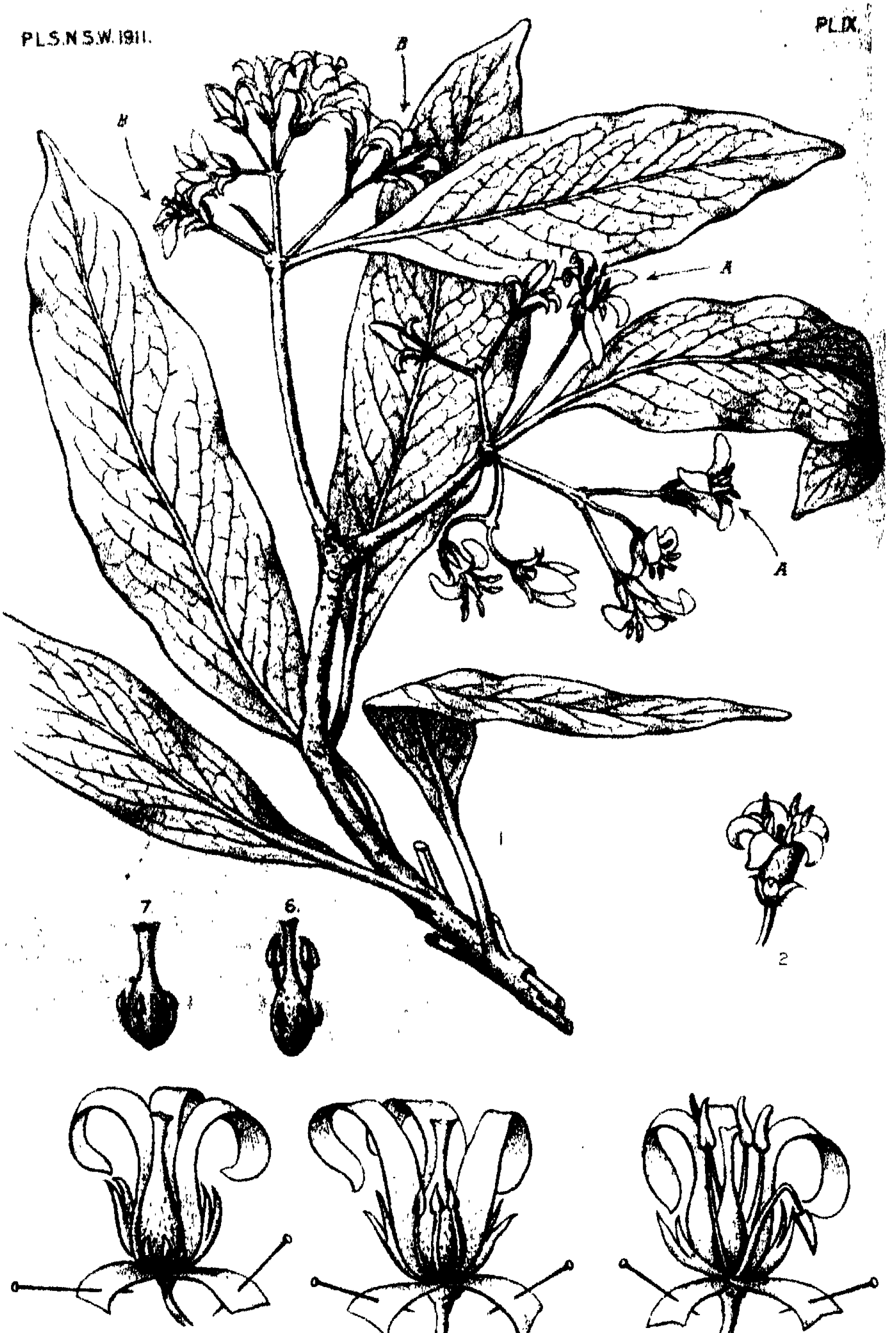
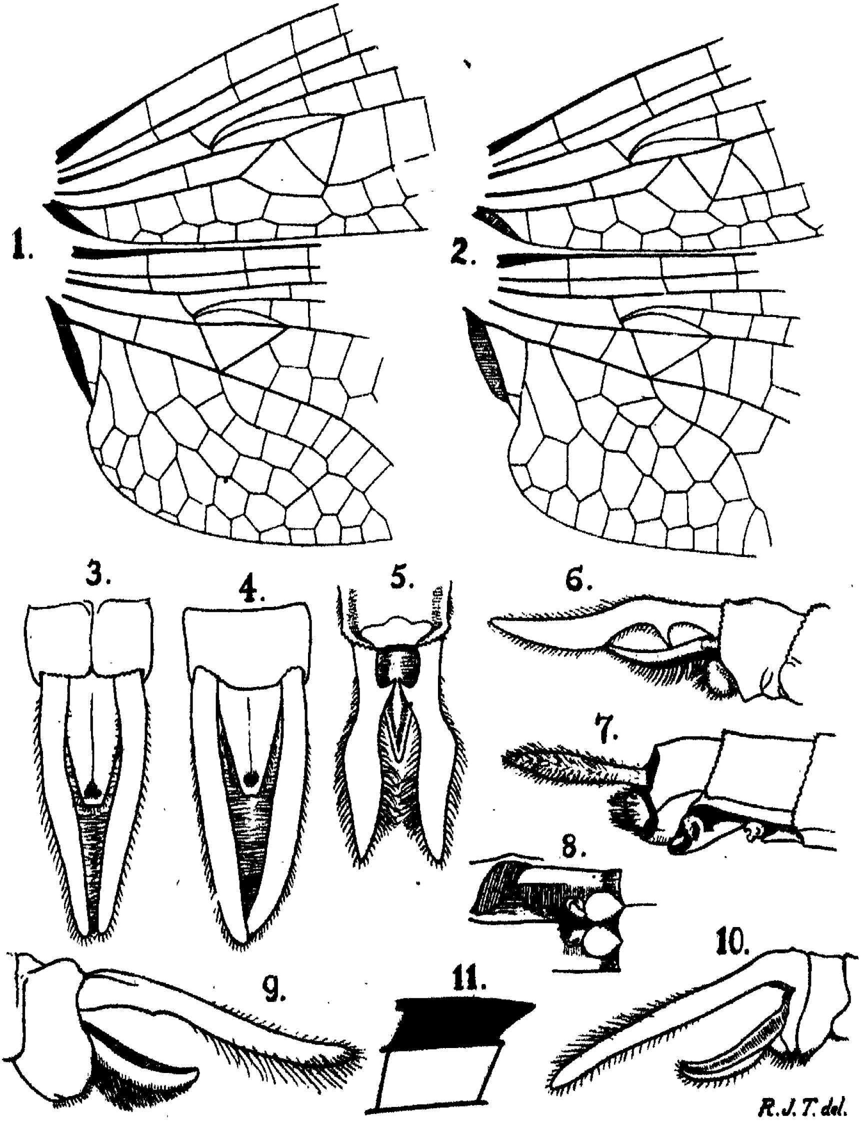
Platycilibe brevis, n. sp.



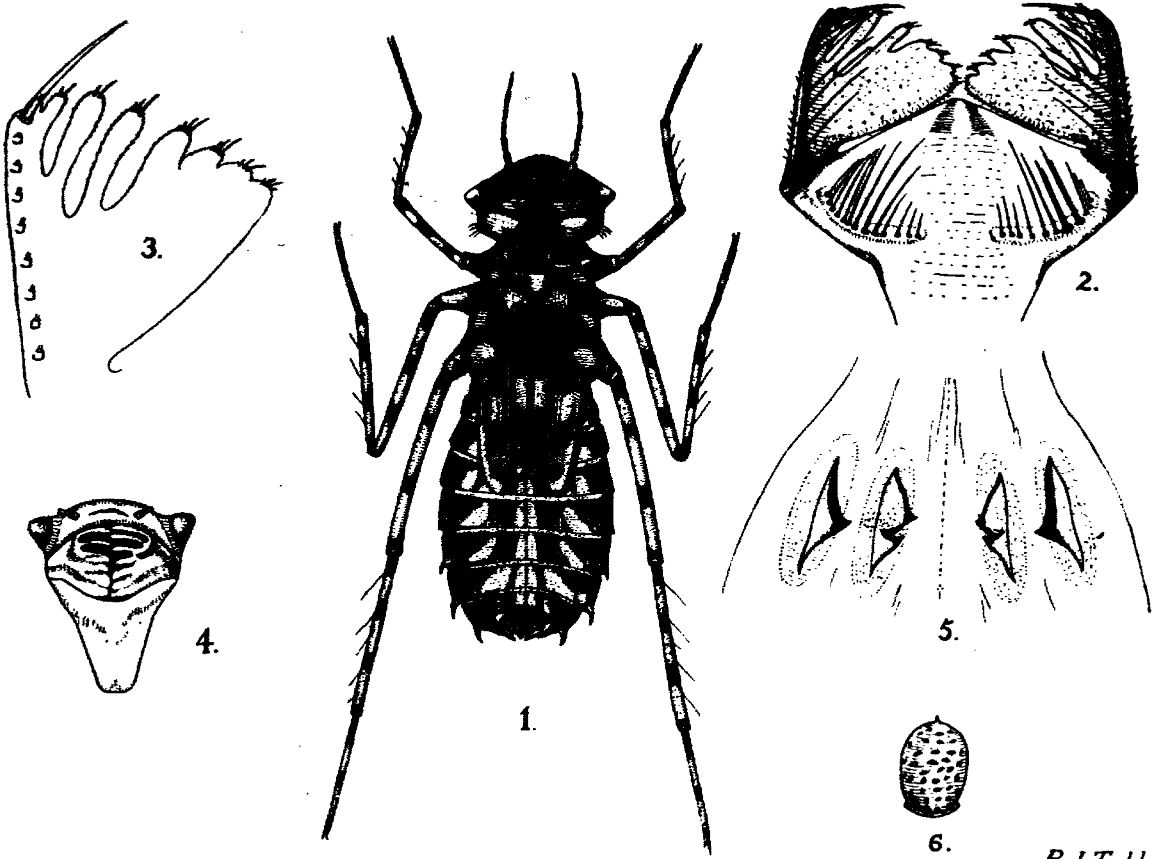
R.T.B. del.

H.J.A.Baron, lith

PITTOSPORUM UNDULATUM, *Andr.*

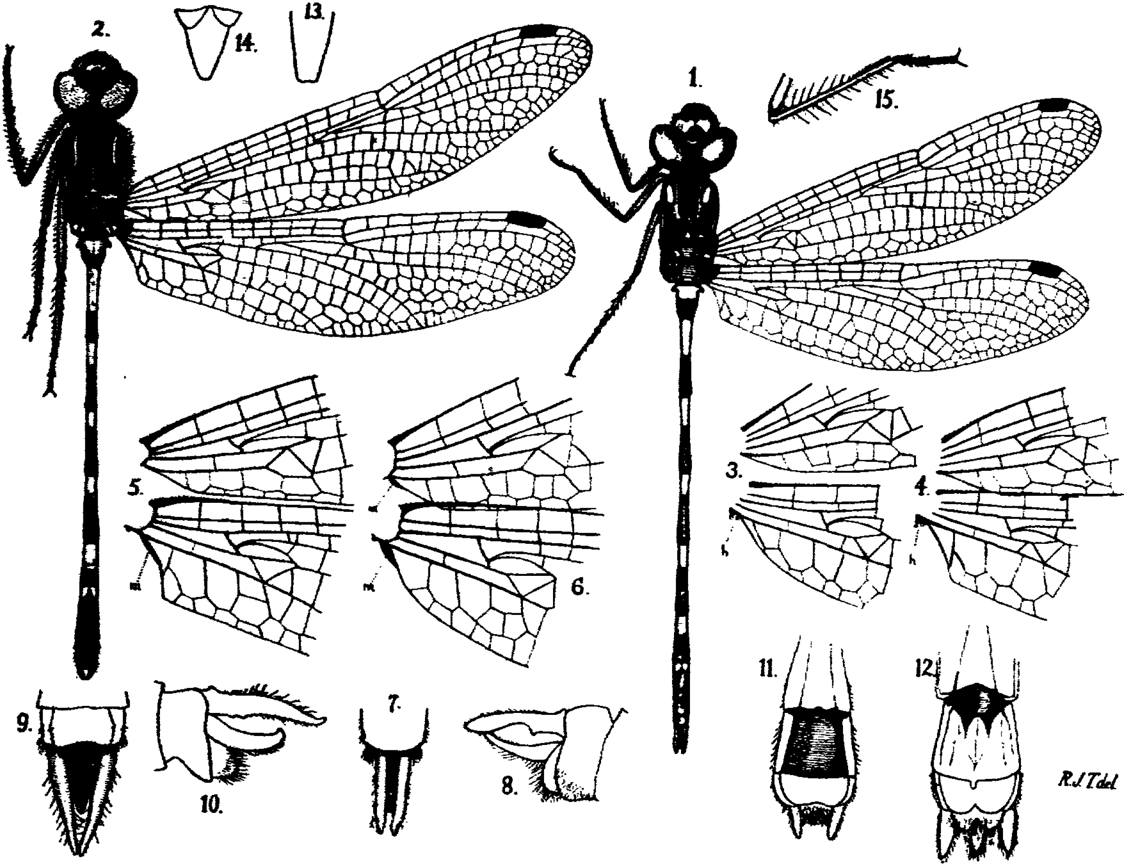


Australian *Corduliinæ*.

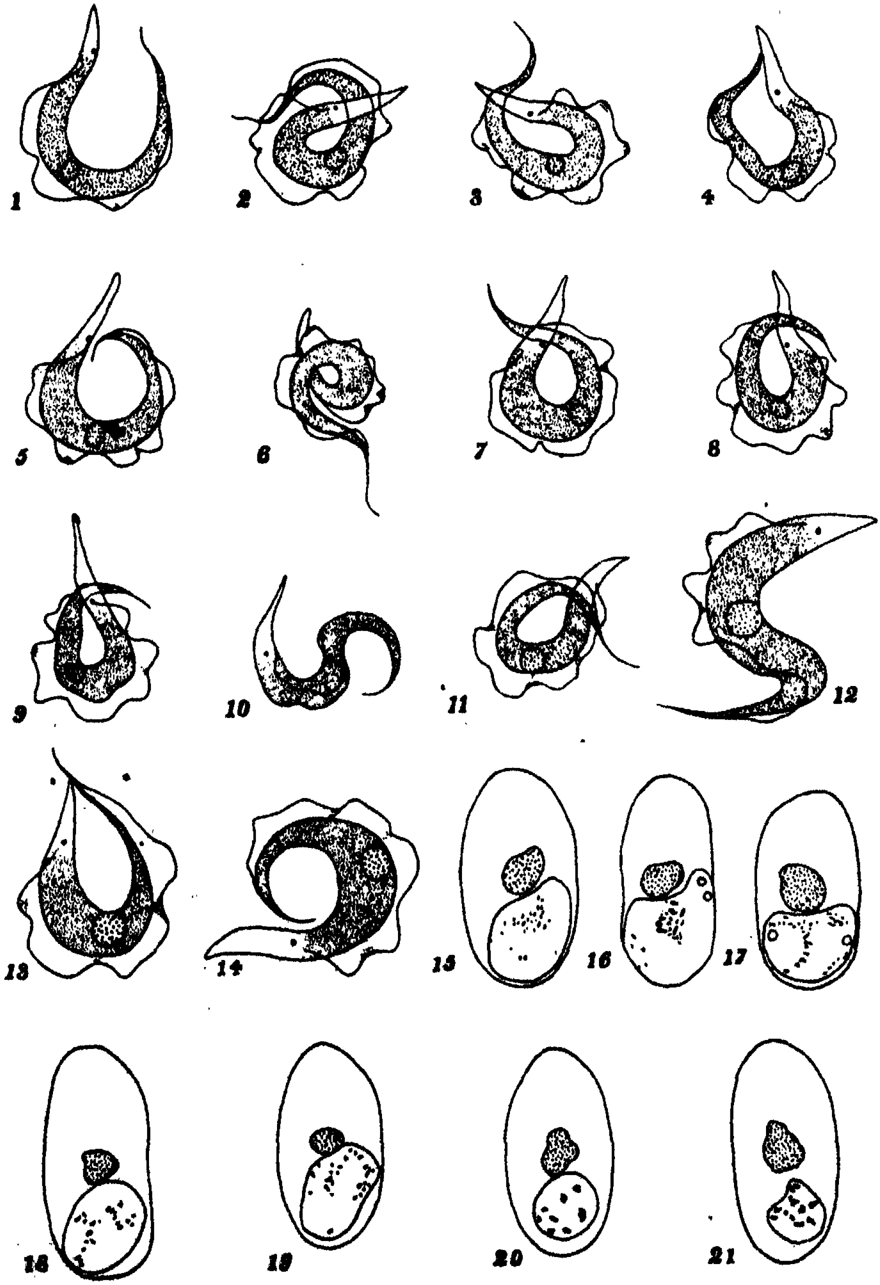


R.J.T. del.

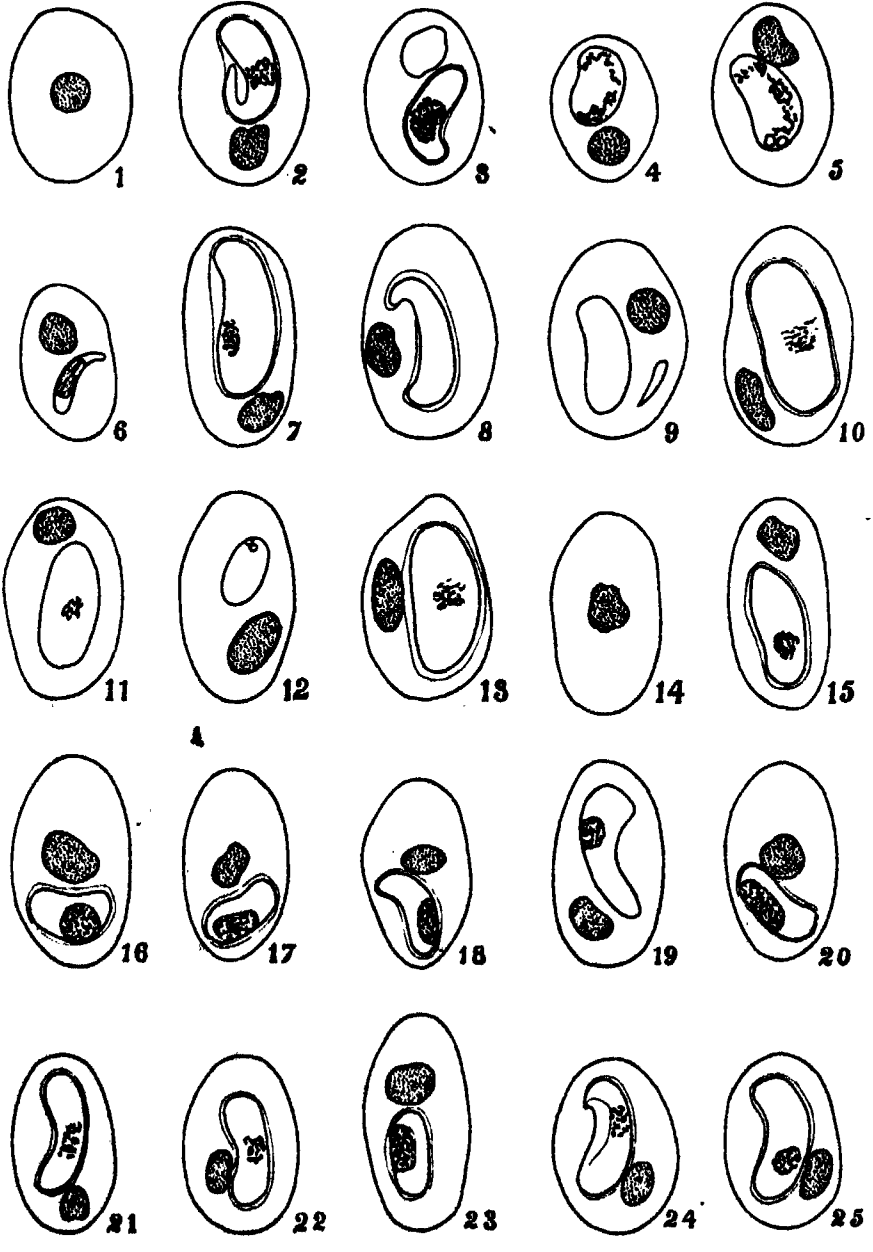
Genus *Cordulephya*.



Genus Cordulephya.

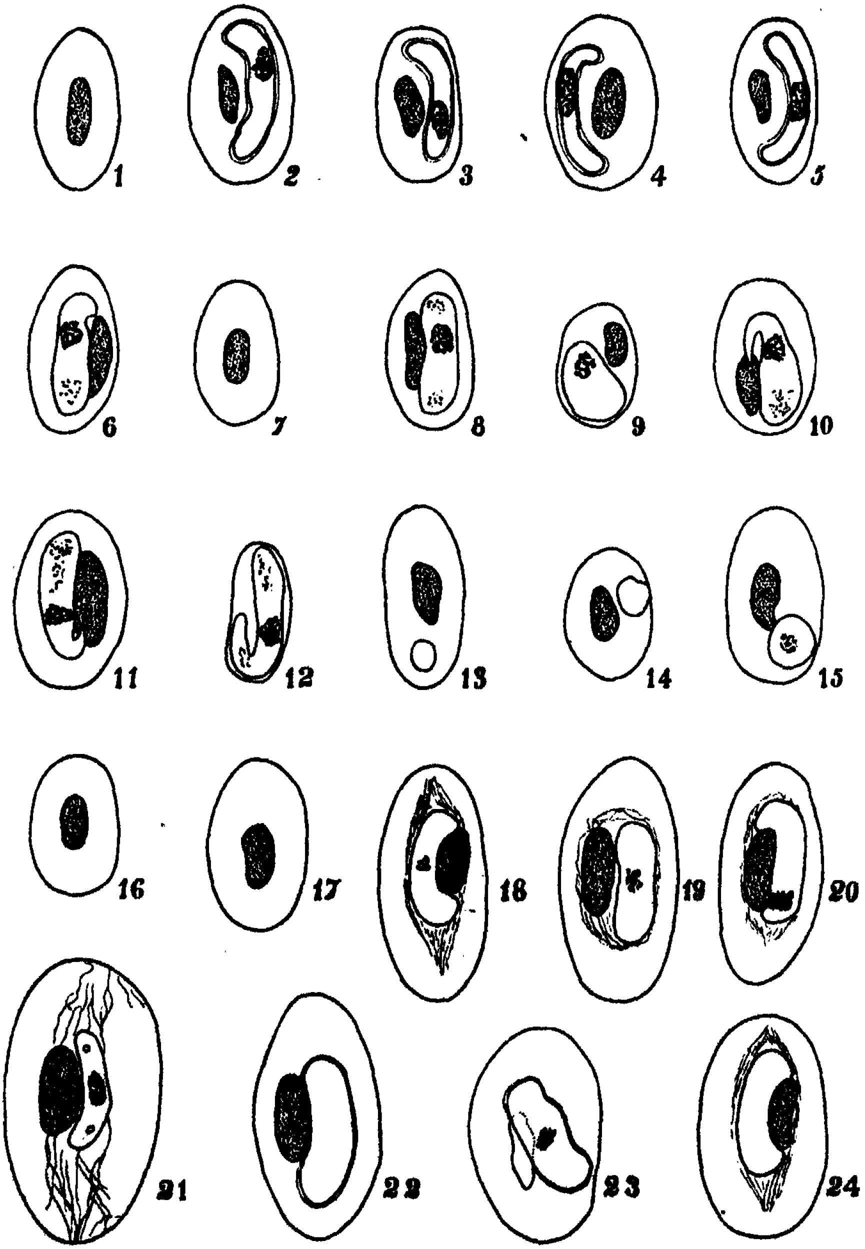


Reptilian Hæmatozoa.

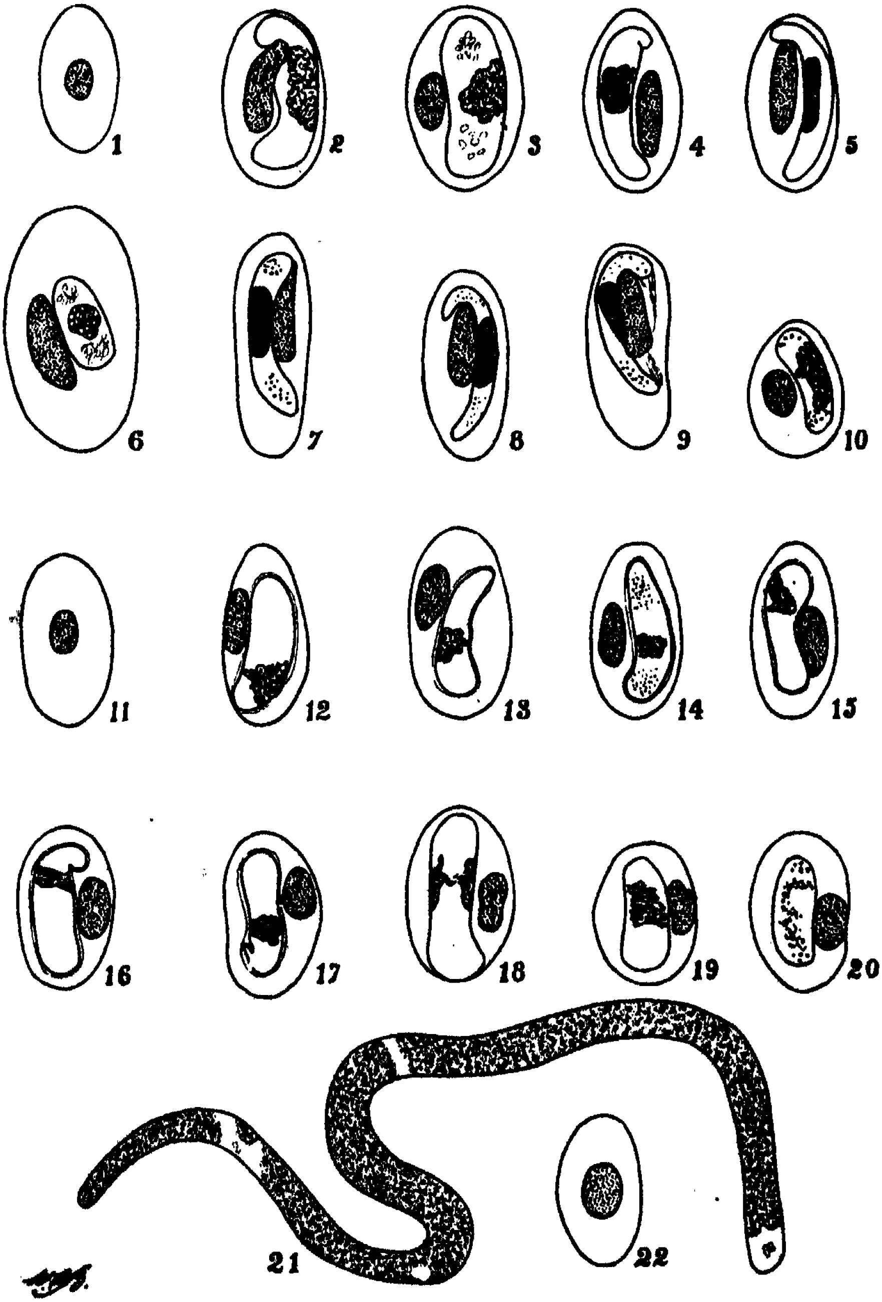


Reptilian Hæmatozoa.

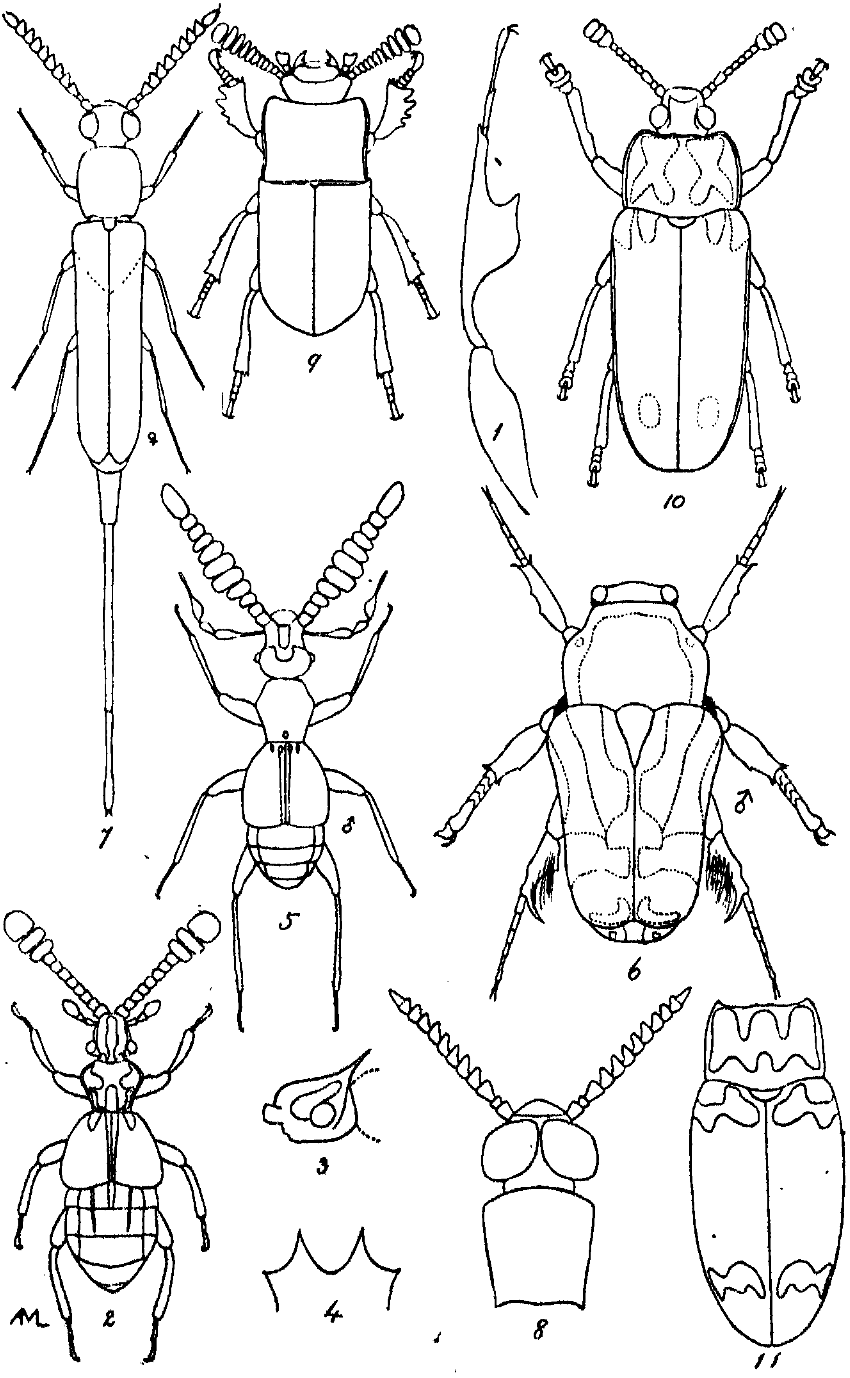
PL. XV.



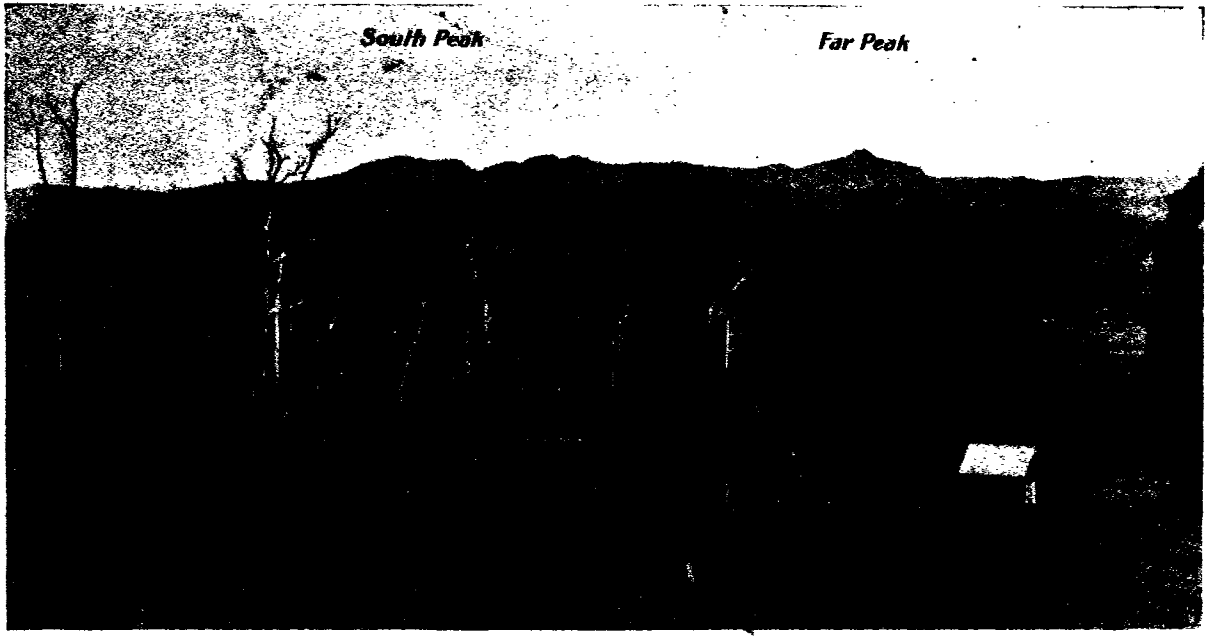
Reptilian Hæmatozoa.



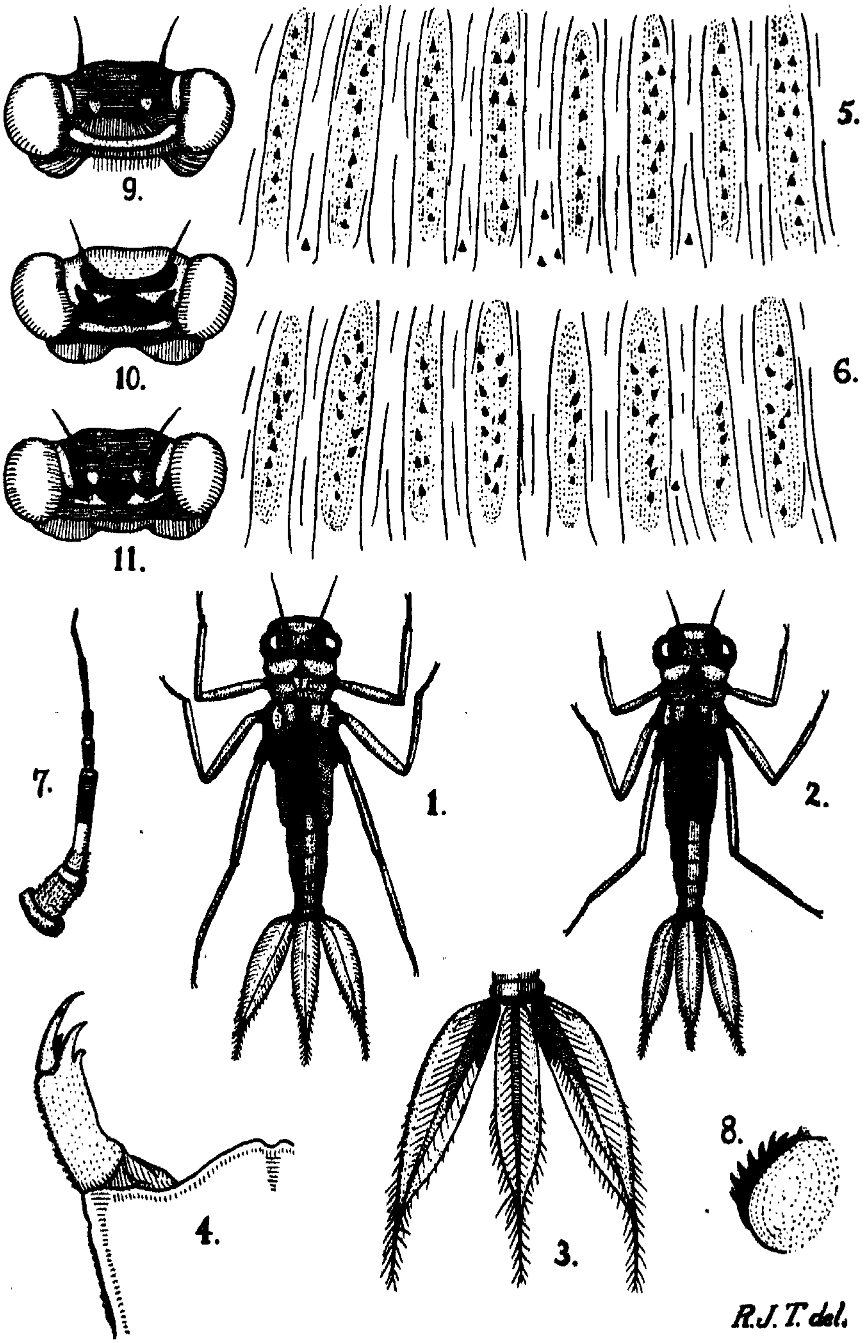
Reptilian Hæmatozoa.



Australian Coleoptera.

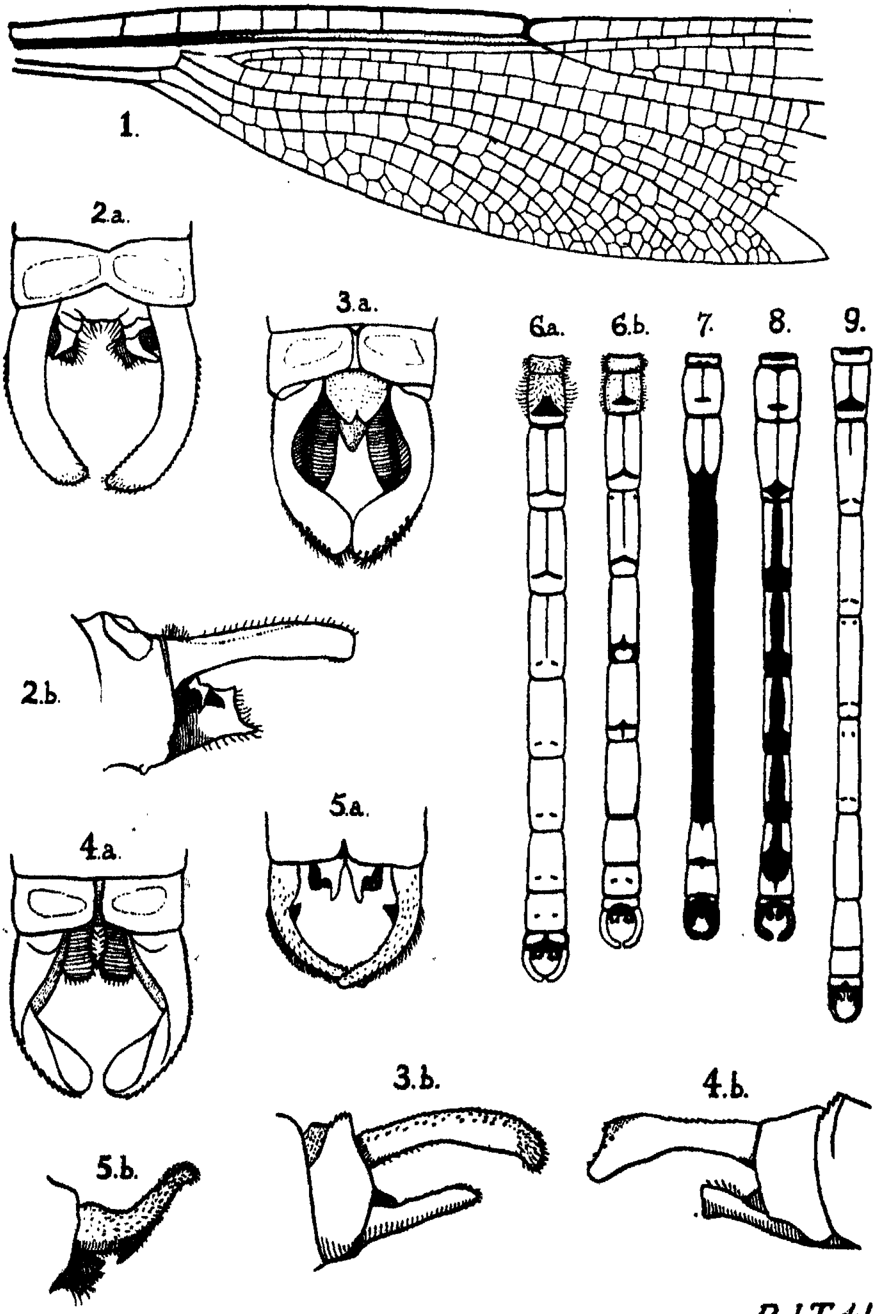


The Peaks, Yerranderie (looking west from the Wollondilly River).



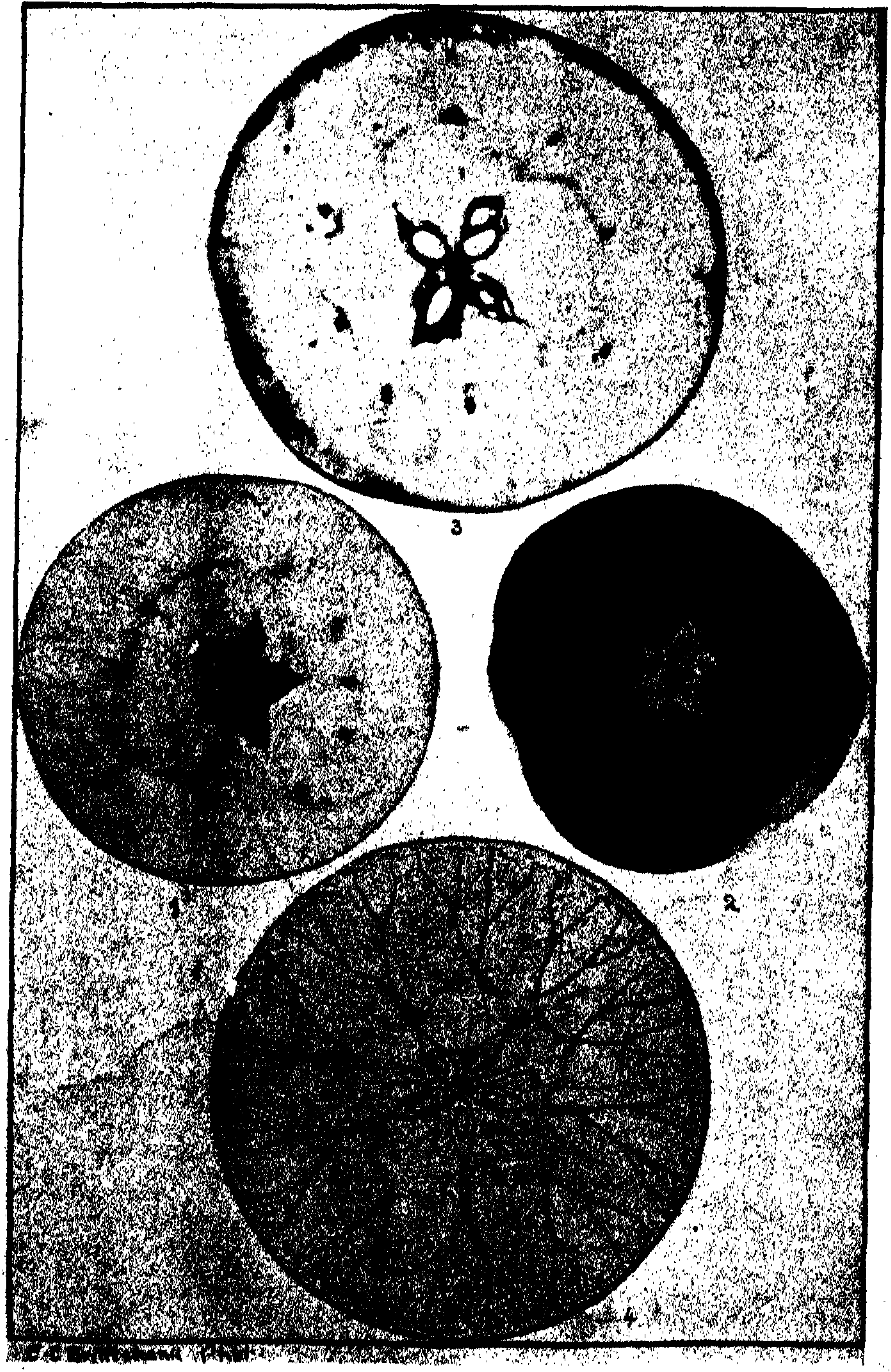
R.J.T. del.

Diphlebia spp.

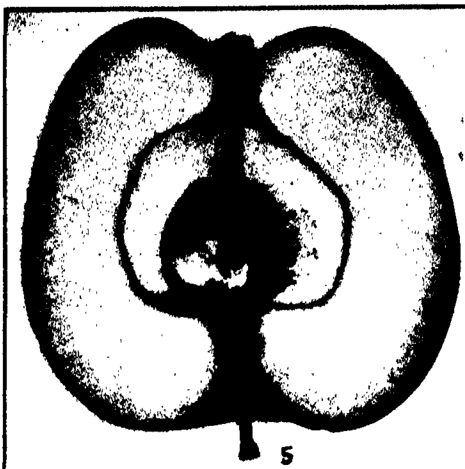


R.J.T. del.

Diphlebia spp.



Transverse Sections of Apple.



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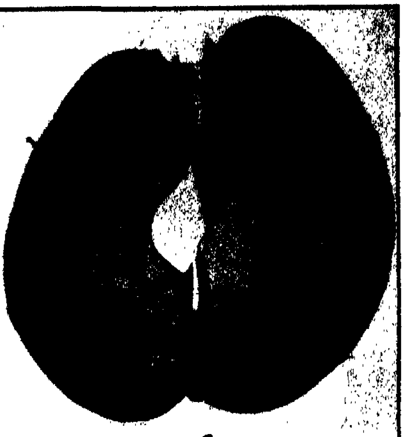

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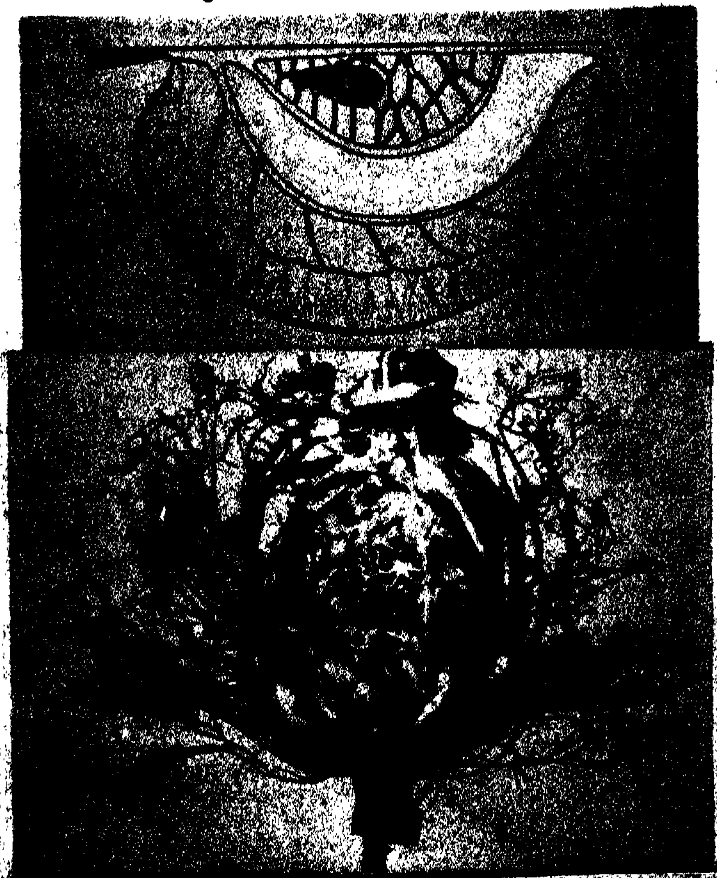
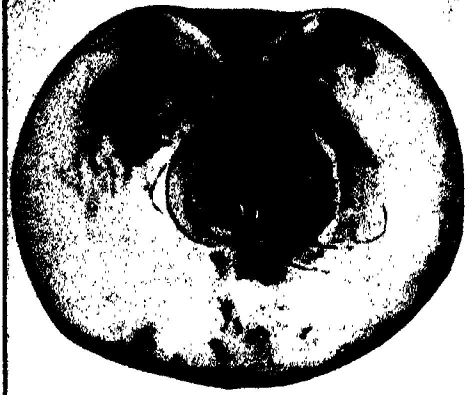


Longitudinal Sections, and Vascular System of Apple.



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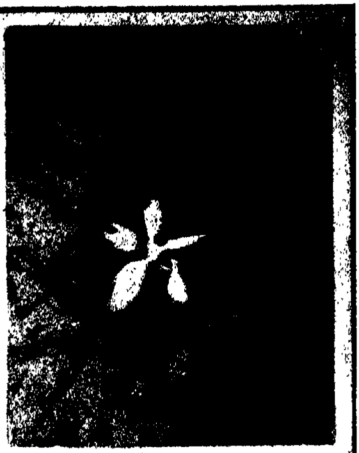

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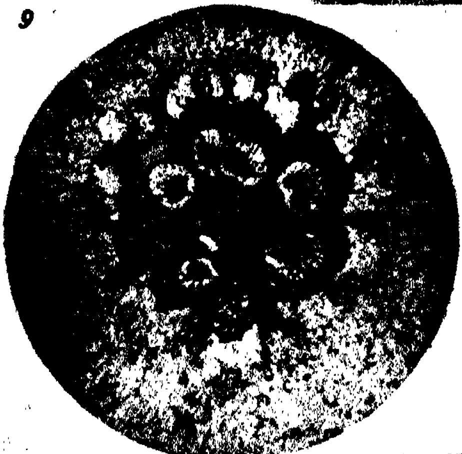

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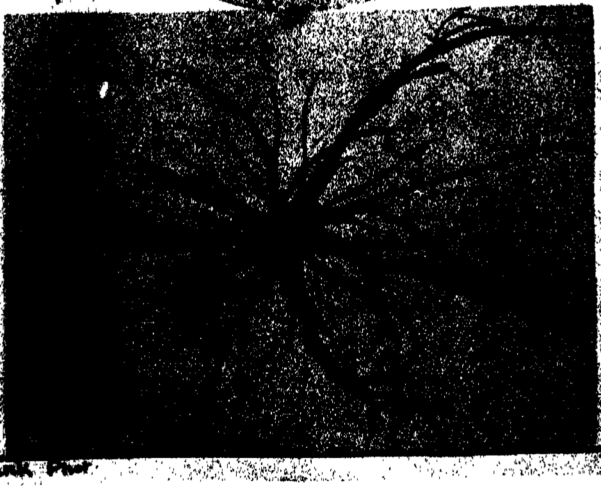
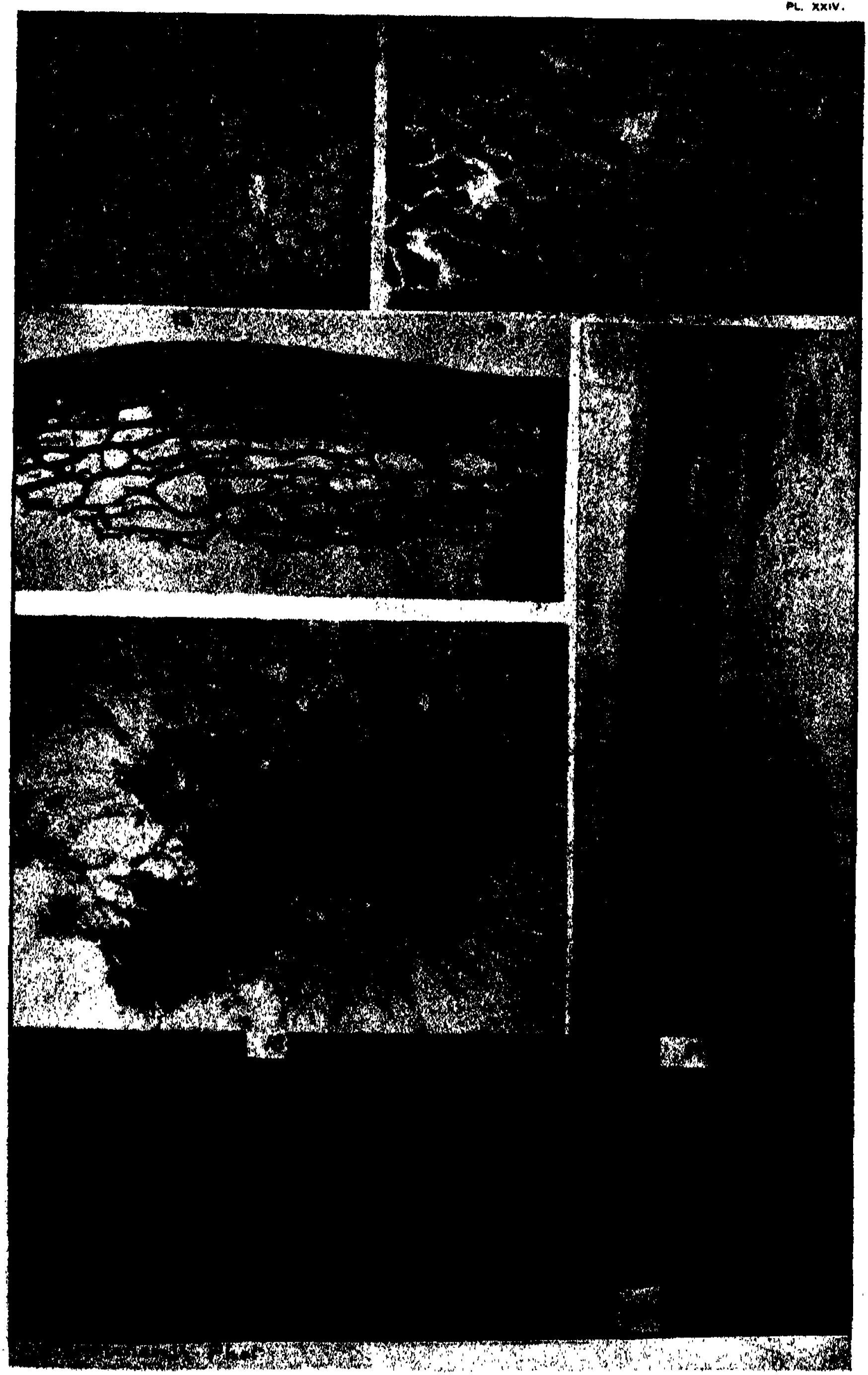
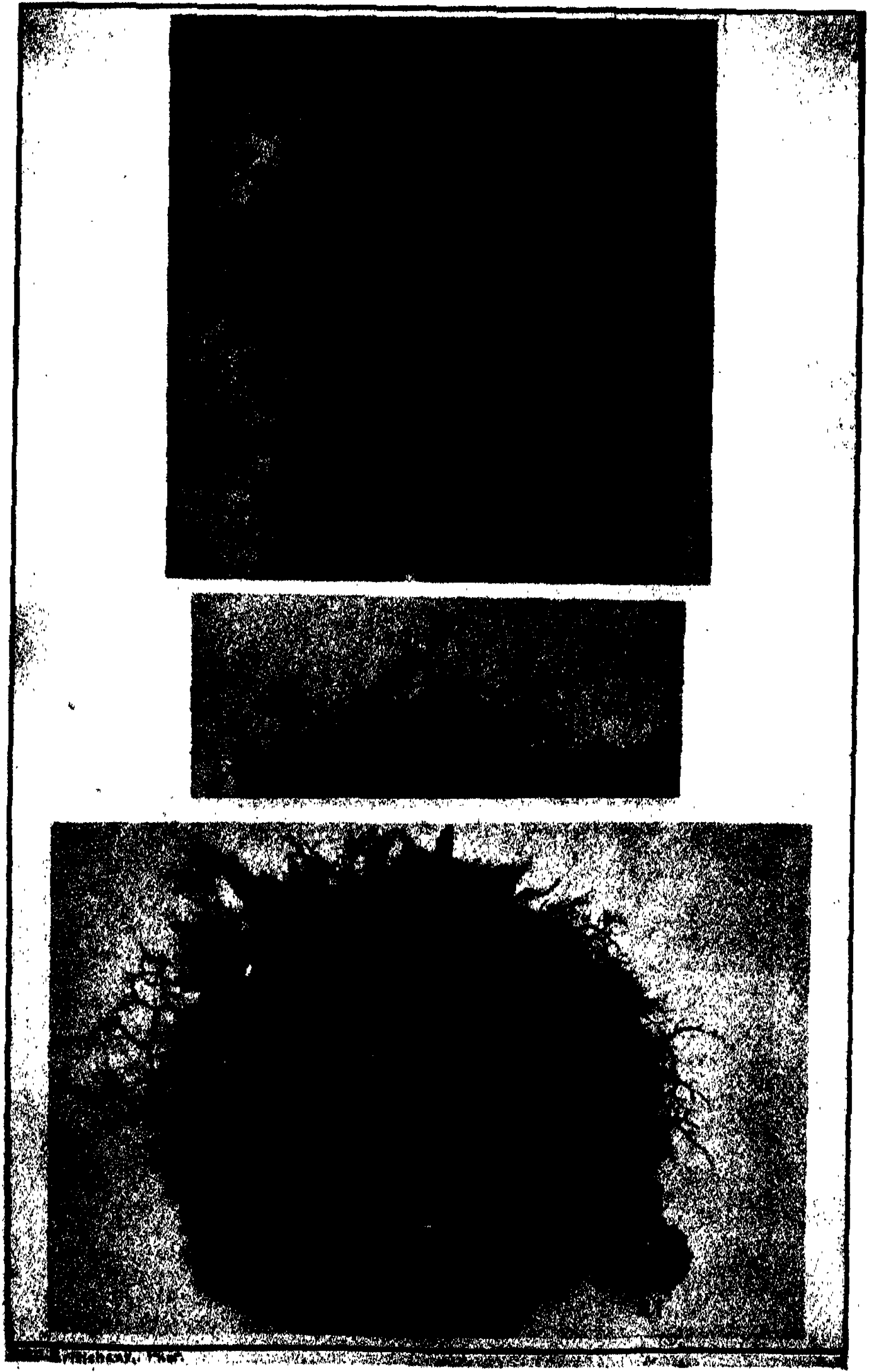


[illegible] Cruikshank, Phot.

Core and Vascular Bundles of Apple.

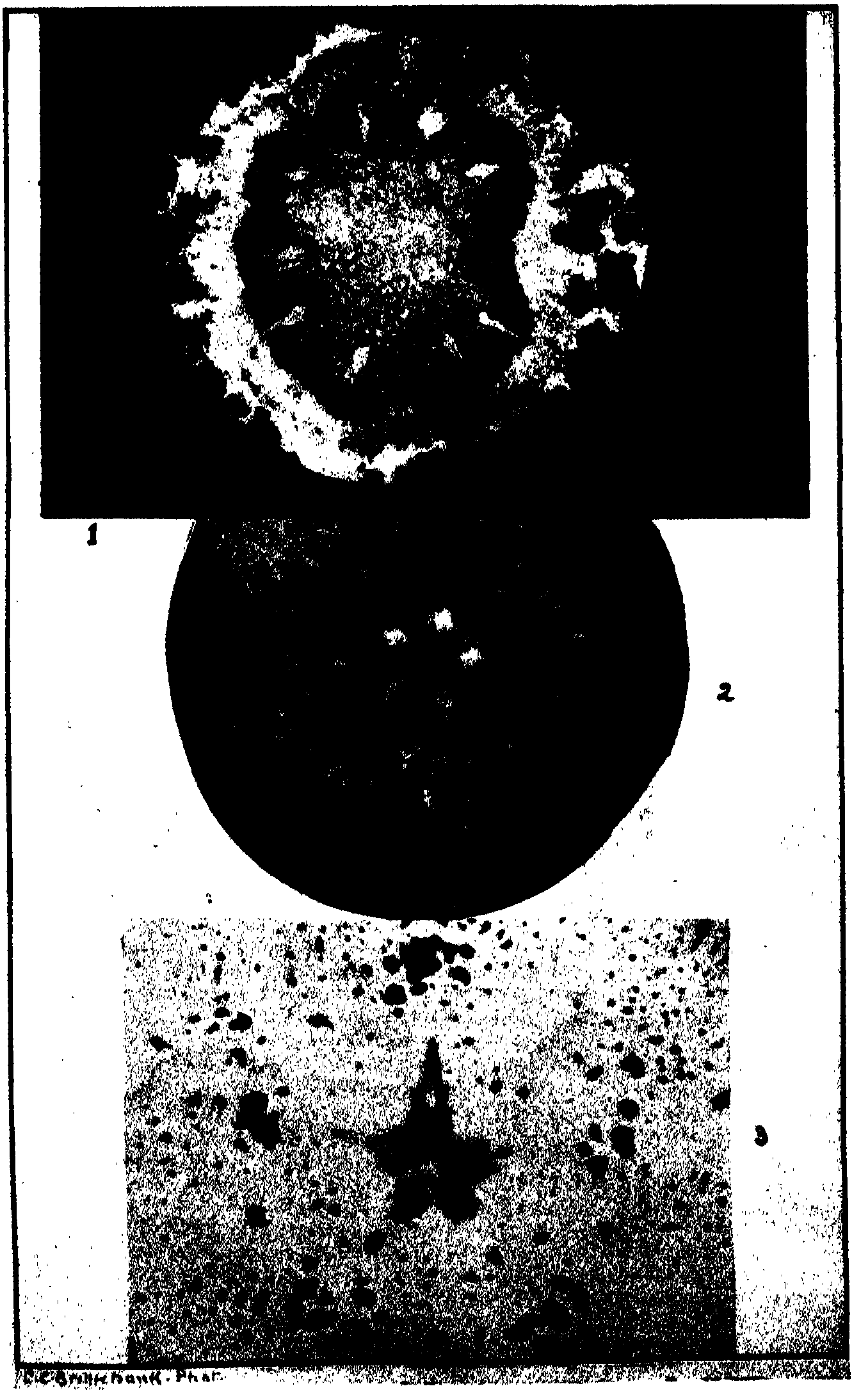


Epidermis and Vascular Bundles of Apple, with Skeleton of Leaf.



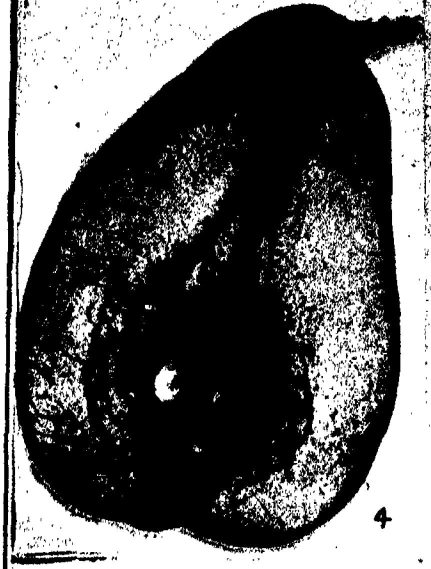
Whitehead, Photo.

Apple, showing Vascular Network, and projecting Branches.



E.C. Cruikshank. Phot.

Cross-Section of Stalk and Fruit of Pear.



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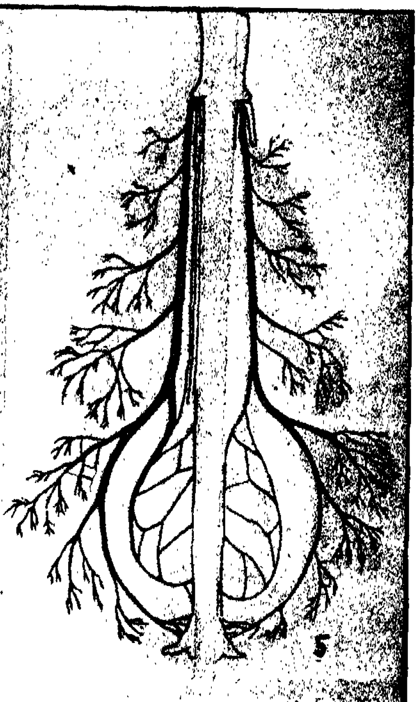

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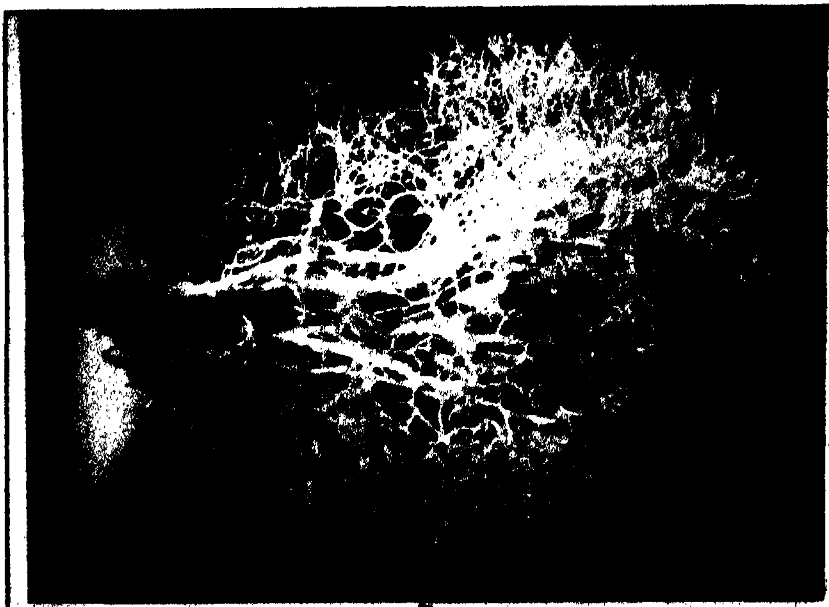
S. Brinkhurst, Phot.

Longitudinal Sections of Pear, showing Vascular Bundles.



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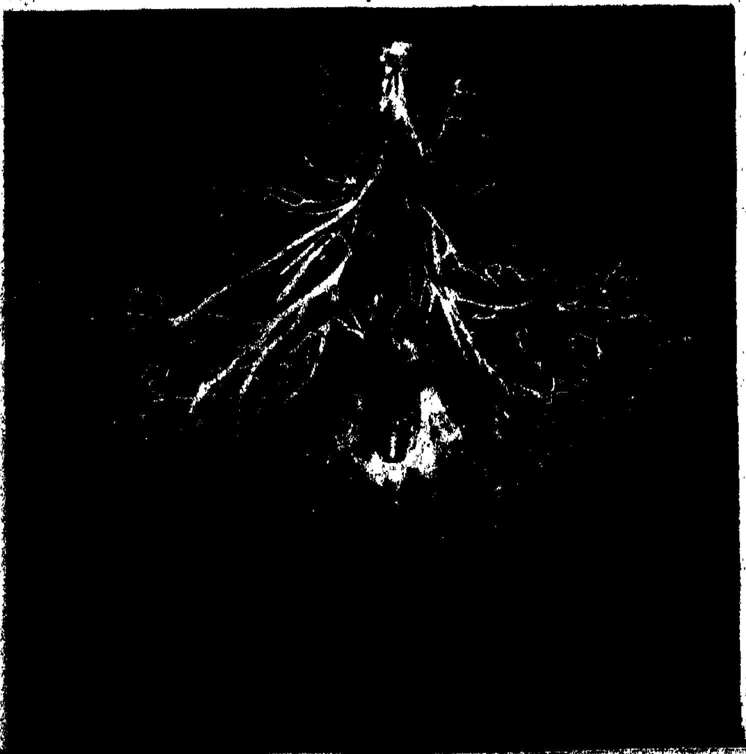
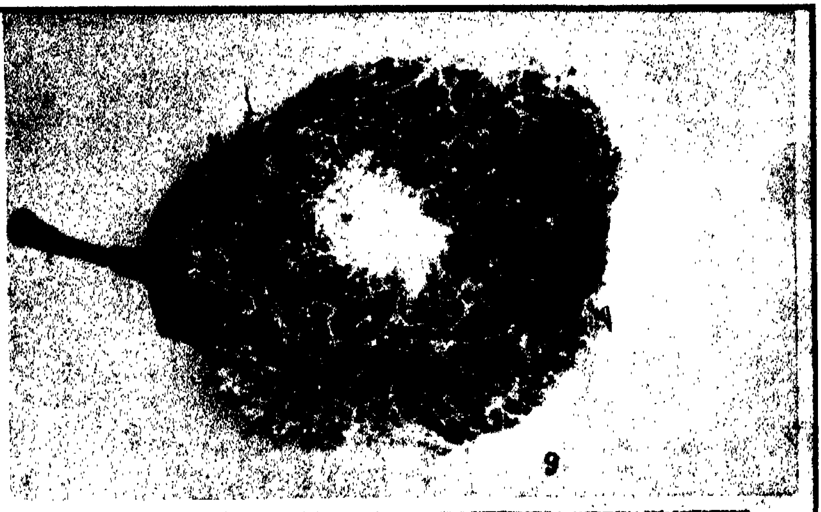


8

General Distribution of Vascular Bundles of Pear.



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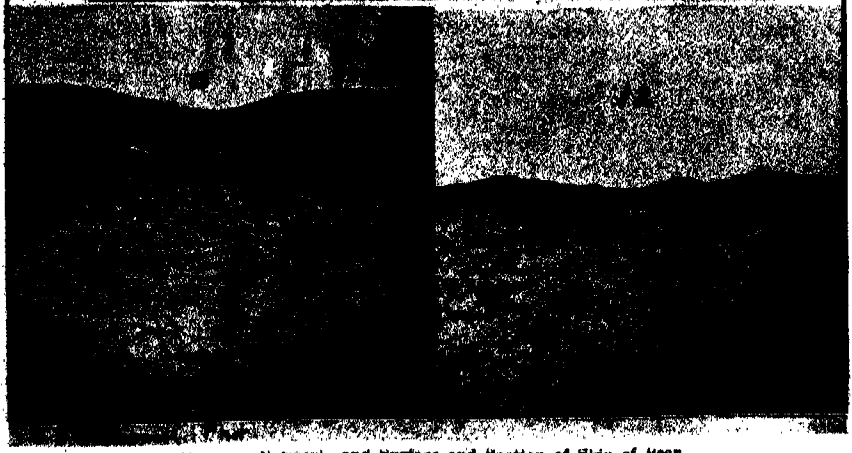
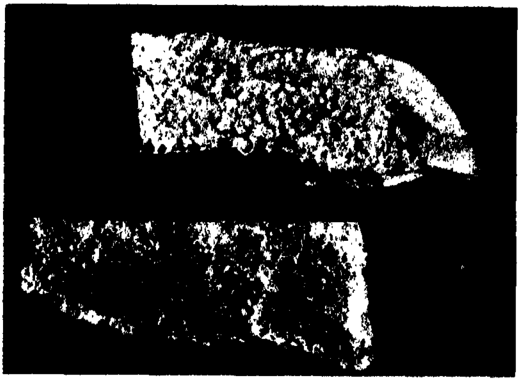


Vascular Network, and Surface and Section of Skin of Pear.



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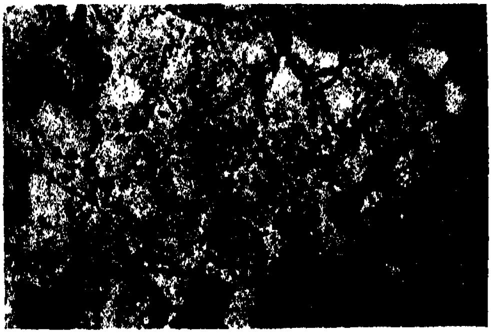

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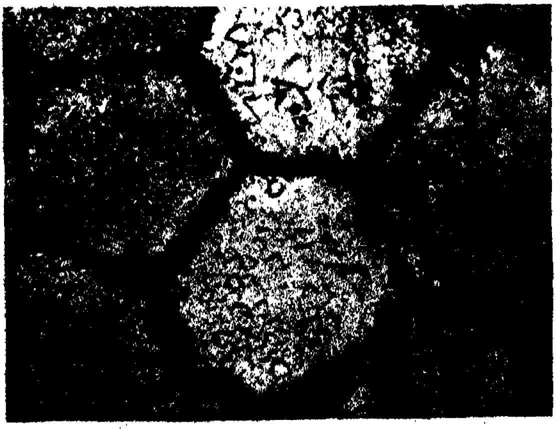

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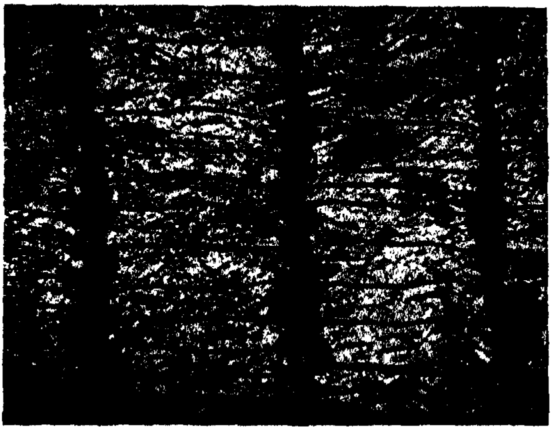
Favosites tripora, n. sp.



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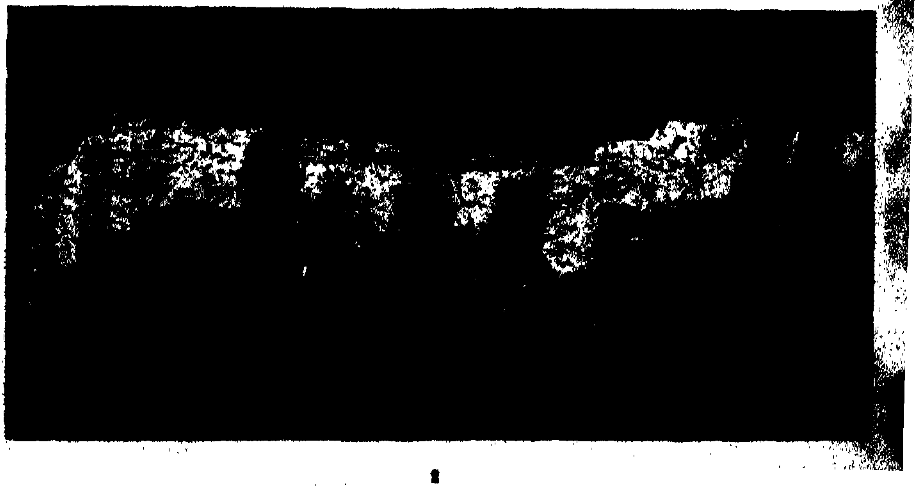

2

Favosites tripora, n. sp.

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